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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b> <small>(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))</small>	Attorney Docket No.	APXX0003
	First Inventor or Application Identifier	Cazalet et al.
	Title	Method and System of Managing AC Power Networks...
	Express Mail Label No.	EL540886468US

<b>APPLICATION ELEMENTS</b> See MPEP chapter 600 concerning utility patent application contents.	<b>ADDRESS TO:</b> Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing)	5. <input type="checkbox"/> Microfiche Computer Program (Appendix)
2. <input checked="" type="checkbox"/> Specification [Total Pages 75] (preferred arrangement set forth below) - Descriptive title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure	6. <input type="checkbox"/> Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary) a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies
3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 22] 4. Oath or Declaration [Total Pages 3] a. <input checked="" type="checkbox"/> Newly executed (original or copy) b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) (for continuation/divisional with Box 16 completed) i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).	<b>ACCOMPANYING APPLICATION PARTS</b> 7. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s)) 8. <input checked="" type="checkbox"/> 37 C.F.R. § 3.73(b) Statement of Power of Attorney (when there is an assignee) <input checked="" type="checkbox"/> 9. <input type="checkbox"/> English Translation Document (if applicable) 10. <input checked="" type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input checked="" type="checkbox"/> Copies of IDS Citations 11. <input type="checkbox"/> Preliminary Amendment 12. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) (Should be specifically itemized) 13. <input checked="" type="checkbox"/> * Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application, (PTO/SB/09-12) Status still proper and desired 14. <input type="checkbox"/> Certified Copy of Priority Document(s) (if foreign priority is claimed) 15. <input type="checkbox"/> Other:

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**STATEMENT CLAIMING SMALL ENTITY STATUS  
(37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN**

Docket Number (Optional)  
APXX0003

Applicant, Patentee, or Identifier: Cazalet et al.

Application or Patent No.: \_\_\_\_\_

Filed or Issued: Herewith

Title: Method and System of Managing AC Power Networks Based Upon Flow Gate Market ....

I hereby state that I am

- ☐ the owner of the small business concern identified below:  
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN Automated Power Exchange

ADDRESS OF SMALL BUSINESS CONCERN 10455-3 Bandlely Drive, Cupertino, CA 95014

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

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- ☒ the specification filed herewith with title as listed above.  
☐ the application identified above.  
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:

- ☐ no such person, concern, or organization exists.  
☒ each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

EDWARD G.

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Applicant or Patentee: Edward G. Cazalet, Chengjun Fu, Ralph Samuelson,  
John Stremel, and Tichomir Tenev  
Serial No.: \_\_\_\_\_ Filing Date: Herewith  
Patent No.: \_\_\_\_\_ Issued: \_\_\_\_\_  
For: METHOD AND SYSTEM OF MANAGING AC POWER NETWORKS BASED UPON  
FLOW-GATE MARKET TRANSACTIONS

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS**  
**37 CFR 1.9(f) and 1.27(b) - INDEPENDENT INVENTOR**

As a below-named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled:

**METHOD AND SYSTEM OF MANAGING AC POWER NETWORKS BASED  
UPON FLOW-GATE MARKET TRANSACTIONS**

described in:

- (x) the application filed herewith  
( ) application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
( ) patent no. \_\_\_\_\_, issued \_\_\_\_\_

I have not assigned, granted, conveyed, or licensed and am under no obligation under contract or law to assign, grant, convey, or license any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- (x) no such person, concern, or organization  
( ) persons, concerns, or organizations listed below\*

\* NOTE: Separate verified statements are required from each named person, concern, or organization having rights to the invention averring to their status as small entities (37 CFR 1.27).

FULL NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
( ) INDIVIDUAL ( ) SMALL BUSINESS CONCERN ( ) NONPROFIT ORGANIZATION

FULL NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
( ) INDIVIDUAL ( ) SMALL BUSINESS CONCERN ( ) NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

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Signature of Inventor

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03/30/00



## **METHOD AND SYSTEM OF MANAGING AC POWER NETWORKS BASED UPON FLOW-GATE MARKET TRANSACTIONS**

### Technical field

This invention relates to methods of controlling electrical power transmission,  
5 more specifically, AC electrical power transmission in a frequency controlled AC  
power network.

### Background Art

Ever since the invention of AC power technology, this and many other countries  
have benefited from the ability to share the use of AC electrical power across  
10 great distances. This AC power technology has proven to be of enormous value.  
However, the management and control of AC power networks have shown  
themselves to have fundamental problems. But before discussing these  
problems, it is important to consider some basic physical properties  
distinguishing AC power distribution systems from other flow based systems  
15 such as DC power, gas, water and oil transmission systems.

An AC power network is an electrical network connecting AC power generators  
to AC power loads on power lines controlled so that the network as a whole can  
be seen to function at an essentially constant frequency and uniform phase  
across the network. Drifts in phase are compensated by phase shifting devices  
20 to enforce the uniform phase property across the AC power network. Drifts in  
frequency are compensated at the generators. Such frequency variations are  
typically caused by variances between the loads and generated power. The  
effect of these compensations is to operationally provide essentially constant  
frequency and uniform phase throughout the AC power network. The AC power  
25 distribution frequency in the United States, Canada, Mexico and some other  
countries is 60 Hz and in some other countries is 50 Hz. In certain cases, the

power is distributed in a 2-phase transmission scheme. In certain other instances, the power is distributed in a 3-phase transmission scheme.

A grid as used herein will refer to an electrical power system which may comprise more than one AC power network as well as DC power lines which may transfer energy between nodes of different AC power networks or between nodes of a single AC power network.

Cities, generators and the like act as the nodes of an AC power network. A specific node may actually comprise more than one generator or load. A bus locally connects these local facilities of a node. High voltage AC transmission lines transfer power between the cities and the generators in major load centers of an AC power network. By way of example, in the United States, there's an AC power network that covers what is called the Western States Coordinating Council, which goes from British Columbia in Canada down to Northern Mexico and over to the Rocky Mountains. There's another AC power network in Texas and there's another AC power network essentially covering the rest of the United States and Canada, with the exception of a portion of Quebec. These three AC power networks are connected together by direct current lines to form the North American grid. They're not connected in AC. They are asynchronous, in that they are not synchronized either in terms of frequency or phase across the United States, Canada and northern Mexico.

Another property distinguishes AC power networks from gas, water, oil and other fluid flow distribution systems. In AC power networks, changes in power generation and loading propagate across such networks at approximately the speed of light, so that the effect of power generation and power loading on a network effects the whole network in a manner that, for practical purposes, is simultaneous.

Due to the stability of frequency and phase across an AC power network, changes in power have a super positioning effect. This insures that the power

being carried on any line in the network is essentially a linear function of the generators and loads on the network. Furthermore, if a path of lines connects two nodes, generating power at the first node carried by the path is offset by power generated at the second node, as related by the just mentioned linear function.

These AC power networks are operated within a safe range, so that the patterns of flows are fairly predictable, given the configuration of the network does not change. The North American Electric Reliability Council computes a system of a set of numbers called transfer distribution factors available on the North American Electric Reliability Council website, [www.nerc.com](http://www.nerc.com), showing how the power is distributed across these various lines. It is a linear function of the amount injected, which changes sign when the direction of transfer changes from Node1 to Node2 into Node2 to Node1. Such functions are skew symmetric with respect to the nodes.

Consider a DC network: one can directly control the delivery of power from one point to another. This cannot be done on AC power networks. It is a characteristic of AC power networks that all lines are affected in roughly fixed proportions, the previously mentioned transfer distribution factors, by the generating and loading at specific nodes.

By way of example, when AC power is sent from Bonneville Power Authority in the state of Washington to San Francisco, some of it comes down the direct path and some of it comes down through Idaho to Arizona and back up from Southern California to Northern California. One may be limited in what can be brought from the Bonneville Power Authority to San Francisco because there's a problem with the flow coming up from Southern California to Northern California.

Consider an AC power network. There can be unlimited number of sources and loads in that network. Eventually though, the network runs out of capacity. There are certain lines or collections of lines of the network that are going to run out

ahead of others and those constrained flow elements are a big problem for the electricity industry. These lines may typically be limited either by line carrying capacity or by transformer capacity limits associated with those lines. Note that there may be more than one transformer involved and that different transformers may have differing transformer capacity limits. These constrained flow elements are called flow gates. In the last few years the importance of flow gates has begun to emerge through the actions of NERC, which has been responsible for building a model estimating flow gate impact, which can be downloaded from their web site.

A flow gate of a given AC power network will refer herein to a collection of at least one line whose total maximum safe carrying capacity will act as a congested element of the network, constraining AC power delivery between two or more nodes of that network.

All lines have maximum safe carrying capacities and thus could be considered flow gates, of a sort. However, historical congestion analysis of specific AC power networks reveals that only a small number of flow gates account for almost all congestion problems. Such flow gates will be herein referred to as significant flow gates. Note that maximum safe carrying capacity is usually defined in terms of the overall system network reliability, which includes more than just what conditions that cause line failure.

The associated AC power transfer across a given flow gate is additive due to the super positioning effects previously discussed. Thus in sending 100 megawatts along a path, the transmission may have a 10% impact on the flow gate, putting 10 megawatts on the flow gate. A second generator may have a 5% impact on that flow gate. Generating 100 megawatt at the second generator would add 5 across the flow gate.

Figure 1 depicts an exemplary AC power network based upon contemporary AC power technology as found in the prior art. The network contains 12 nodes labeled **10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110** and **120** respectively.

AC transmission line **12** runs between node **10** and node **20**. Line **14** runs  
5 between node **10** and node **40**. Line **22** runs between node **20** and node **30**.  
Line **32** runs between node **30** and node **40**. Line **42** runs between node **40** and  
node **120**. Line **44** runs between node **40** and node **60**. Line **46** runs between  
node **40** and node **50**. Line **52** runs between node **50** and node **110**. Line **54**  
10 runs between node **50** and node **60**. Line **56** runs between node **50** and node  
**70**. Line **62** runs between node **60** and node **110**. Line **64** runs between node **60**  
and node **70**. Line **82** runs between node **80** and node **90**. Line **92** runs between  
node **90** and node **120**. Line **94** runs between node **90** and node **110**. Line **96**  
runs between node **90** and node **100**. Line **102** runs between node **100** and  
node **110**. Line **112** runs between node **110** and node **120**.

15 Flow gate A **210** is a constraint on the network. Lines **32, 34** and **42** are  
constrained by flow gate A **210** by a total maximum safe carrying capacity, in that  
these lines have transmission capacity limitations which are easily overloaded  
when this maximum safe carrying capacity is exceeded.

Flow gate B **220** is a constraint on the network. Lines **42** and **44** are constrained  
20 by flow gate B **220**. These lines are also constrained by a total maximum safe  
carrying capacity due to system limitations, such as their proximity at some  
critical junction of the system, such as a mountain pass.

Flow gate C **230** is a constraint on the network. Lines **52** and **62** are constrained  
by flow gate C **230** to a total maximum safe carrying capacity.

25 Figure 2 depicts a list of associated AC power transfer functions for each flow  
gate of a collection of flow gates for each of the buses of the various nodes of  
the exemplary AC power network of Figure 1 as disclosed in the prior art.

Bus 1 locally connects all facilities of Node 10. Bus 2 locally connects all facilities of Node 20. Bus 3 locally connects all facilities of Node 30. Bus 4 locally connects all facilities of Node 40. Bus 5 locally connects all facilities of Node 50. Bus 6 locally connects all facilities of Node 60.

- 5 Bus 7 locally connects all facilities of Node 70. Bus 8 locally connects all facilities of Node 80. Bus 9 locally connects all facilities of Node 90. Bus 10 locally connects all facilities of Node 100. Bus 11 locally connects all facilities of Node 110. Bus 12 locally connects all facilities of Node 120.

10 Note that the facilities at these nodes, connected by the associated bus, often varying greatly in terms of generation capacity as well as loading capacity. By way of example, a city often consumes far more AC power than it generates. Another example, a node for a major hydroelectric dam such as Grand Coulee Dam would tend to generate far more AC power than it consumed.

15 Note that the associated AC power transfer functions for the various buses are all fractions of 1, since the most power that could be transferred is the amount of power at the generation node. Note further that some of these AC power transfer functions are negative. Bus 11 has strictly zeroes for its power transfer function. It is essentially acting as a reference node for calculating the associated functions. Note that identification of the reference node is done for  
20 convenience. Any bus can serve as the reference node.

Consider how AC power transfers are managed today. In the United States, the Federal Energy Regulatory Commission (FERC) has called for the development of Regional Transmission Organizations (RTOs) to better coordinate markets and foster reliability (in FERC Docket No. RM99-2-000 issued May 13, 1999).  
25 The electric power industry has a long history of using centralized dispatch to manage generation, as opposed to open markets. Centralized dispatch was suited to an industry consisting of vertically integrated monopolies. The traditional approach to RTO design so far has been to retain as much of this

centralized control as possible, while opening access to competitive wholesale and retail participants. The result has been volatile prices, settlement disputes, and difficulties matching supply and demand on a real-time basis. The basic problem is that centralized dispatch does not work well where participants do not  
5 have common ownership or objectives.

Today, transmission rights are further considered and negotiated in terms of point-to-point transfers within the network using a system known as contract paths. This contract path system of scheduling power transmission reserves transmission rights along a particular, direct path through the AC power network.  
10 This is done by purchasing transmission rights from each of the transmission line owners for each of the lines making up the direct path.

Such thinking is contrary to the previously discussed physics of these AC power networks, because changes in power generation or load at any node have an essentially linear effect on all transmission lines in the network, and  
15 consequently impact all flow gates within that network to some extent. It often occurs that some constraint, occurring across a significant flow gate off that direct path, actually limits the transmission capability on the direct path.

The contract path system maintains the fiction that AC power can be directed to follow a path through the network chosen as one might with natural gas. By changing the valves, one can mythically direct AC power a particular way  
20 through the AC power network. The contract path system was put in place because it was thought conceptually easier since one only had to make reservations along the single path. The fundamental problem with the contract path approach is that the contract path arrangement for transmission does not  
25 accord with the way the power actually flows in an AC power network.

Today's contract path system is based upon a first-come, first-served priority scheme. What is bought has very limited resale capability. By way of example, consider three nodes A, B and C of an AC power network. Suppose one bought

power transmission from A to B and bought transmission from B to C. Using the contract path approach, this does not necessarily mean one owns power transmission from A to C, because contract paths are not additive. Owning power transmission from A to B and from B to C would not necessarily entitle  
5 power transmission from A to C. To transport from A to C, one might have to purchase specific transmission rights from A to C. This is because of regulatory rules often reflecting some flow gate constraint which would not be met in the two separate paths which would be triggered in the combined path. So in the contract path based market, which is the traditional market, once you have  
10 purchased the transmission from A to B, it's only value is often for moving energy from A to B. This is a common experience when all three nodes are in the same control area.

It is actually worse than indicated. There are numerous times and places when owning rights from A to C does not insure that anything can be delivered from A  
15 to C, even without critical events in the network. The grid reliability operators often cut transmission due to congestion, which may not even be on the contract path. Today, there are several ad hoc approaches to limiting flow on one path because of the impact on another path. The central operator acts, because some flow gate will otherwise overflow.

20 Another alternative approach to the contract path system is to take all of these generator cost curves, and the buyer preference functions, into a mathematical optimization program, and figure out the optimal flow. This alternative approach has significant disadvantages. In a commercial market, getting people to reveal all their costs is quite difficult. Most people are very  
25 reluctant to do that. Further, such costs frequently change. The buyers have to reveal their preferences, which is a tremendous informational burden. It is also extremely unlikely that they could or would do it. Even if they did, collecting all this information is a tremendous burden on the central operator.



Such an alternative approach requires two-way communication among all the players, with all these generators, loads, transmission devices and systems to control over a wide region. It has proven impossible to provide the requisite level of reliable communication and direct control systems. Besides, people  
5 are unwilling to turn over control of their lives to a central operator, even if they are willing to divulge their preferences and costs.

A similar approach in industry is a power pool called PJM, for Pennsylvania, New Jersey and Maryland, who have developed a system called locational marginal pricing. It is a central dispatched methodology. However, a local flow  
10 model is buried within it. It supports some centralized management of generators and such in order to get a consistent solution that is based upon the power distribution matrix.

This approach suffers from at least the same problems facing any other centralized control scheme. There is a very limited amount of detailed  
15 information such a system can acquire, or use, to optimize AC power transfers. The power users are again blind to their options. The players cannot determine what works best for them. The central operator dictates such things to them. It is difficult to imagine that such a situation could be optimal. Worse yet, no one knows what the price of energy will be until long  
20 after it has been consumed! While there are some hedging mechanisms which have been developed, this doesn't change the fact that users are consuming power at an unknown price at the time of consumption.

NERC has developed a methodology addressing flow gates to some extent. This is discussed in a document entitled "Discussion Paper on Aligning  
25 Transmission Reservations and Energy Schedules to Actual Flows", distributed in November, 1998 by the NERC Transaction Reservation and Scheduling Self-Directed Work Team. This team proposed an electrical power industry shift to a system of reserving and scheduling transmission based on actual use of

congested flow gates, which they called the FLOWBAT method. Their proposal suffers from a serious omission, it does not address the issue of allocating flow gate capacity when demand exceeds supply. By their silence on this issue, it appears that they would continue the current practice of first-come, first-served allocation. The flaws discussed above for centralized planning continue to be relevant in this approach.

NERC has also sponsored the General Agreement on Parallel Paths Experiment (GAPP). GAPP is a system whereby one transmission provider compensates a second transmission provider for the parallel power flows occurring on a second transmission provider's system caused by transactions authorized by the first transmission provider. GAPP relies on distribution functions, in this case called Transaction Participation Functions (TPFs). These distribution functions refer to transmission paths rather than flow gates. GAPP attempts to align compensation paid by transmission users with actual power flows. However, GAPP is strictly an after-the-fact settlement system. It alters the current contract path scheme only to redistribute the revenue. It does not attempt to allocate scarce transmission capacity.

Notice that none of the prior contracting methods provide any incentive for proactive congestion relief by the players even though opportunities to resolve congestion problems often exist. Every prior approach is based upon a central operator making unilateral actions. There is no opportunity for collective problem solving by the players before transmission occurs.

To summarize, what is needed is an AC power transmission market system complying with the physics of AC power networks. Further, since transmission rights are predominantly constrained by significant flow gates, what is needed should account for the effect on the significant flow gates for each contracted transmission.

What is further needed is a method and mechanism by which such transmission rights across significant flow gates can be traded in a timely, reliable and efficient manner which automatically guarantee correct operation of the AC power network.

5

Disclosure

Certain embodiments fulfill at least the requirements and needs discussed with regards to the prior art.

Certain embodiments include a method for contracting AC power transfer on an AC power network with a flow gate collection containing at least one flow gate.

10

The method comprises contracting an AC power transfer on the AC power network, further comprising contracting an associated AC power transfer on each of the flow gates of the flow gate collection. Such a method automatically insures that the associated flow gate AC power transfer has been contracted for each flow gate of the flow gate collection.

15

Certain further embodiments of contracting an AC power transfer include contracting the AC power transfer to take place over a time interval. Contracting the associated AC power transfer on each flow gate of the flow gate collection further includes contracting the associated AC power transfer on each flow gate of the flow gate collection to take place at least over the time interval. Such

20

embodiments advantageously insure that the associated AC power transfer is contracted for each flow gate of the flow gate collection over the time interval.

25

Certain further embodiments include contracting an AC power transfer collection of at least two AC power transfers on an AC power network. This further comprises contracting a sum of the associated AC power transfers for each of the AC power transfers of the AC power transfer collection on each of the flow gates of the flow gate collection. Such a method automatically insures that the associated flow gate AC power transfer has been contracted for each flow gate

of the flow gate collection, given the collection of AC power transfers being contracted.

Certain embodiments take into account that each flow gate of the flow gate collection has an associated maximum safe carrying capacity. Contracting the sum of associated AC power transfers on each flow gate comprises the sum of the associated AC power transfers for each AC power transfer of the AC power transfer collection satisfying the associated maximum safe carrying capacity on each flow gate of the flow gate collection. This automatically insures that the associated flow gate AC power transfer for the collection of AC power transfers satisfies the maximum safe carrying capacity of each flow gate.

Each AC power transfer of the AC power transfer collection has an associated amount of energy from an associated first node of the AC power network to a second node of the AC power network. Certain embodiments include contracting an amount of energy of the associated AC power transfer on each of the flow gates of the flow gate collection as essentially an associated linear, skew-symmetric function of the associated amount of energy from the associated first node to the second node. Such embodiments are further advantageous in complying with the observed physical characteristics of AC power networks and flow gates on such AC power networks. Additionally, this physical characteristic of AC power transfer can be used in trading to alter the AC power transfer collection so that it no longer exceeding the maximum safe carrying capacity on any of the flow gates.

Note that in certain further embodiments, enabling the first party to further contract to sell the first party owned AC power transfer trading rights further enabling the first party to further contract to sell the associated AC power transfer for a single flow gate, as well as, for all the flow gates. Such embodiments advantageously provide a fluidity for market forces to move toward optimal operating solutions based upon the internal needs and goals of the market players which cannot be attained by centralized control systems.

In certain embodiments, the first party may be a human being. In certain further embodiments, the first party may be a corporate entity. In certain further embodiments, the first party may be an agent authorized to represent the first party. In certain further embodiments, the agent may be a software agent  
5 executing on a computer. These embodiments provide the users and suppliers of AC energy to trade AC power transfer rights in terms of flow gates, removing the necessity of a centralized control system dominating the operation of such AC power networks.

In certain embodiments, a computing system comprised of at least one computer  
10 with coupled computer readable memory provides for the execution of a program operating system containing program code segments supporting the operations of the above discussed embodiments. Such embodiments provide an execution environment advantageously supporting these operations.

In certain further embodiments, the computing system further includes a client  
15 computer collection, a server system and a network. The client computer collection contains at least one client computer operated by a client. The server system contains at least one server computer. The network couples the client computer of the client computer collection and coupling at least a first of the server computers of the server system. Contracting the AC power transfer on  
20 the AC power network further comprises identifying a first of the clients operating a first of the client computers as the first party. Such embodiments advantageously provide clients operated computers communicating in a secure fashion with the server system.

In certain further embodiments, a first client user operating the first client  
25 computer as the first party residing on the computer readable memory coupled to the first client computer includes the following operations: receiving stimulus from the first user, communicating via the network with the first server computer and displaying an interactive status. This advantageously provides basic support for

a user interface to the contracting mechanism for AC power transfers on the AC power network.

In certain further embodiments, contracting the AC power transfer on the AC power network further comprises communicating via the network with the first client computer. This advantageously provides for the reception of the client computer communication as part of the contracting process.

In certain further embodiments, contracting for AC power transfer further includes operating a virtual trading floor containing a market for trading AC power transfer for each of the flow gates of the flow gate collection. In certain further embodiments operating the virtual trading floor for AC power transfer further include transforming the received server delivery stream into an order collection and contracting to create an agreed contract based upon a first bid order and a first ask order. These embodiments advantageously support a bid and ask order system of trading.

In certain further embodiments, the virtual trading floor includes at least one market interval associated with each flow gate of the flow gate collection. This advantageously supports trading in each flow gate AC power transfer in a fashion that directly maps to the physical behavior of the AC power network and its flow gates.

In certain further embodiments, the server system is further comprised of a reliable server collection of server computers performing a reliable distributed system with a process group collection of at least one process group. Each of the server computers is accessibly coupled with a computer memory, of the reliable server system. The program operating system includes program code segments implementing at least one of the process groups of the collection of process groups. Such embodiments advantageously support the above process in a reliable, fault tolerant manner.

These and other advantages of the present invention will become apparent upon reading the following detailed descriptions and studying the various figures of the drawings.

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### Brief Description of the Drawings

Figure 1 depicts an exemplary AC power network based upon contemporary AC power technology as found in the prior art;

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Figure 2 depicts a list of associated AC power transfer functions for each flow gate of a collection of flow gates for each of the buses of the various nodes of the exemplary AC power network of Figure 1 as disclosed in the prior art;

Figure 3 depicts contracting an AC power transfer on an AC power network in accordance with certain embodiments;

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Figure 4 depicts detail operation **1004** of Figure 3 contracting an associated AC power transfer on each of the flow gates of the flow gate collection in accordance with certain embodiments;

Figure 5 depicts detail of operation **1004** of Figure 3 when contracting for AC power transfer to take place over a first time interval in accordance with certain embodiments;

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Figure 6 depicts detail of operation **1022** of Figure 4 contracting the associated AC power transfer on each of the flow gates of the flow gate collection to take place over at least the first time interval in accordance with certain embodiments;

Figure 7 depicts a flowchart contracting an AC power transfer collection of at least two AC power transfers on an AC power network in accordance with certain embodiments;

Figure 8 depicts a detail flowchart of operation **1084** of Figure 7 performing contracting a sum of the associated AC power transfer for each of the AC power transfers of the AC power transfer collection on each of the flow gates of the flow gate collection in accordance with certain embodiments;

5 Figure 9 depicts a detail flowchart of operation **1102** of Figure 8 performing the sum of the associated AC power transfer for each AC power transfer of the AC power transfer collection satisfying the associated maximum safe carrying capacity on each flow gate of the flow gate collection in accordance with certain embodiments;

10 Figure 10 depicts a detail flowchart of operation **1102** of Figure 8 performing contracting each sum of associated AC power transfer for each AC power transfer of the AC power transfer collection to take place at least over the first time interval in accordance with certain embodiments;

15 Figure 11 depicts a detail flowchart of operation **1102** of Figure 8 performing contracting an amount of energy of the associated AC power transfer on each of the flow gates of the flow gate collection as essentially an associated linear, skew-symmetric function of the associated amount of energy from the associated first node to the associated second node in accordance with certain embodiments;

20 Figure 12 depicts a detail of operation **1004** of Figure 3 contracting for the AC power transfer on the AC power network to create an agreed contract by a first party to own AC power transfer trading rights and enabling those rights to be further contracted in accordance with certain embodiments;

25 Figure 13 depicts a flowchart scheduling the AC power transfer on the AC power network with the flow gate collection in accordance with certain embodiments;

Figure 14 depicts a detail flowchart of operation **1186** of Figure 12 performing enabling the first party to further contract to sell the first party owned AC power



transfer trading rights before scheduling the AC power transfer for the agreed contract;

Figure 15 depicts a detail flowchart of operation 1210 of Figure 13 performing scheduling of the AC power transfer for the agreed contract occurring before the first time interval;

Figure 16 depicts a detail flowchart of operation 1214 of Figure 13 performing determining whether the associated AC power transfer of the flow gate of the flow gate collection satisfies the associated maximum safe carrying capacity of the flow gate for each of the flow gates of the flow gate collection over the first time interval;

Figure 17 depicts a detail flowchart of operation 1218 of Figure 13 performing approving the AC power transfer over the first time interval whenever the associated AC power transfer of the flow gate satisfies the maximum safe carrying capacity for each the flow gates of the flow gate collection over the first time interval;

Figure 18 depicts a flowchart performing contracting for an AC power transfer collection of at least one AC power transfer to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow gates of the flow gate collection;

Figure 19 depicts a detail flowchart of operation 1314 of Figure 18 performing contracting for a sum of associated AC power transfers for all AC power transfers of the AC power transfer collection to create a contract for an associated AC power transfer for the collection of AC power transfers for each of the flow gates of the flow gate collection;

Figure 20 depicts a detail flowchart of operation 1332 of Figure 19 performing calculating the associated AC power transfer on the flow gate of the AC power transfer as an amount of energy which is an essentially linear, skew-symmetric

associated function of the amount of energy of the AC power transfer from the associated first node of the AC power transfer to the associated second node of the AC power transfer of each of the flow gates of the flow gate collection;

5 Figure **21** depicts a detail flowchart of operation **1186** of Figure **12** performing enabling the first party to further contract to sell the first party owned AC power transfer trading rights for the associated AC power transfer for a first of the flow gates of the flow gate collection;

10 Figure **22** depicts a detail flowchart of operation **1186** of Figure **12** performing enabling the first party to further contract to sell the first party owned AC power transfer trading rights for the associated AC power transfer for each of the flow gates of the flow gate collection;

Figure **23** depicts a simplified system block of a computing system **2000** supporting contracting AC power transfer on an AC power network with a flow gate collection in accordance with certain embodiments;

15 Figure **24** depicts a refinement of computing system **2000** as a system diagram in Figure **23** in accordance with certain further embodiments;

Figure **25A** depicts a detail flowchart of operation **1000** of Figure **3** performing identifying a first of the clients operating a first of the client computers as the first party;

20 Figure **25B** depicts a flowchart of the first client user operating the first client computer as the first party;

Figure **26** depicts a detail flowchart of operation **1434** of Figure **25B** performing operations related to first client stimulus, response and network communication with a first server computer of the server system;

Figure **27** depicts a detail flowchart of operation **1004** of Figure **3** performing communicating via the network with the first client computer to create a received server delivery stream;

5 Figure **28** depicts a virtual trading floor **3000**, containing validated orders and market intervals with associated market states in accordance with certain embodiments;

Figure **29** depicts a detail flowchart of operation **1004** of Figure **3** performing supporting operating a virtual trading floor containing a market interval for trading AC power transfer for each of the flow gates of the flow gate collection;

10 Figure **30** depicts a detail flowchart of operation **1512** of Figure **29** performing collecting orders and creating contracts in accordance with certain embodiments;

Figure **31** depicts a detail flowchart of operation **1004** of Figure **3** contracting AC power transfer based upon a first bid type order of the validated orders of the validated order collection and a first ask type order of the validated orders of the  
15 validated order collection;

Figure **32** depicts a detail flowchart of operation **1182** of Figure **12** performing contracting for the AC power transfer on the AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow gates of the flow gate  
20 collection based upon a first bid type order of the validated orders of the validated order collection and a first ask type order of the validated orders of the validated order collection;

Figure **33A** depicts a flowchart of operations as previously described which collectively are included in the process groups performed on the reliable server  
25 system in accordance with certain embodiments;

Figure **33B** depicts a method of controlling the interaction between a client **2190** and a virtual trading floor comprising maintaining a session component **3300**, participant component **3320** and market segment **3340** in accordance with certain embodiments;

- 5 Figure **33C** depicts a refinement of computing system **2000** as a system diagram in Figure **24** in accordance with certain further embodiments;

Figure **34** depicts a view of a certified client user interface operating on a client computer showing an ordering screen with hourly time interval based market intervals for a specific energy market in accordance with certain embodiments;

- 10 Figure **35** depicts a view of a certified client user interface operating on a client computer showing an ordering screen for daily on-peak time interval based market intervals for a specific energy market in accordance with certain embodiments; and

- 15 Figure **36** depicts a view of a certified client user interface operating on a client computer showing an ordering screen for hourly time interval based market intervals for a specific flow gate market in accordance with certain embodiments.

#### Detailed Description

- 20 Figures **1** depicts an exemplary network constructed of prior art AC power transmission, distribution, generation and loading equipment showing nodes, lines and a collection of flow gates. Figure **2** depicts a list of associated AC power transfer functions for each flow gate of a collection of flow gates for each of the buses of the various nodes of the exemplary AC power network of Figure **1** as disclosed in the prior art.

- 25 Figure **3** depicts contracting an AC power transfer **1000** on an AC power network in accordance with certain embodiments.

In certain embodiments, operation **1000** starts the operations of this flowchart. Arrow **1002** directs the flow of execution from operation **1000** to operation **1004**. Operation **1004** performs contracting an AC power transfer on the AC power network. Arrow **1006** directs execution from operation **1004** to operation **1008**.

- 5    Operation **1008** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

- 10    As used herein, the term computer refers to devices including instruction set computers, inferential computers, and analog computers, as well as aggregates of these basic kinds of computers. A computer will also refer to informational appliances incorporating one or more computers in their construction. Such informational appliances may be physically distinct units, or they may be tangibly  
15    integrated into other devices, or they may be tangibly integrated into the physically mobile neighborhood of one or more human beings.

- As used herein, certain computers, including instruction-processing computers and inferential computers include coupled computer readable memory to hold what will be termed herein as instructions. Instructions as used herein with  
20    regard to instruction set computers will refer to information controlling state transition of such instruction computers. Based upon the current instruction or collection of instructions being executed and the internal state of the instruction-processing computer will determine the future state of the instruction-processing computer. Note that these instructions may either be directly executed by the  
25    instruction-processing computer or may be interpretively executed by the instruction-processing computer.

Instructions as used herein with regard to inferential computers will refer to information presented to the inferential computer used to infer the future state of

the computer based upon an inference base of the inferential computer directed by the presented instruction. Such an inference base may reside internal to the inferential computer in certain cases, or reside in coupled computer accessible memory, which may be both read and written by the inferential computer. Note  
5 that inferential computers include but are not limited to machines executing various forms of Horn clause predicates as well as constraint rules, pattern recognition templates, fractal pattern templates and fuzzy logic predicate structural elements.

Analog computers as used herein include but are not limited to devices directly  
10 coupling to analog circuitry. Such analog circuitry as used herein includes, but is not limited to, radio frequency IF stages, opto-electronic interfaces such as lasers embedded in fiber optic communications systems, audio and video pattern recognition circuitry, audio and video output devices. Analog computers as used  
15 herein include but are not limited to acoustic interfaces to humans, audio and visual identification portals to the contracting of AC power transfer regarding flow gates, encoding and decoding mechanisms used in long distance communication and interfaces to recording devices of agreed contracts.

A program code segment as used herein refers to instructions in a form executable or inferentially directing for the computer coupled to the computer  
20 readable memory in which the program code segment resides. Note that in certain embodiments, program code segments may be native executable instructions of an instruction-processing computer. In certain other embodiments, program code segments may be interpretively executed instructions of an instruction-processing computer.

25 Figure 4 depicts detail operation 1004 of Figure 3 contracting an associated AC power transfer on each of the flow gates of the flow gate collection in accordance with certain embodiments.

Arrow **1020** directs the flow of execution from starting operation **1004** to operation **1022**. Operation **1022** performs contracting an associated AC power transfer on each of the flow gates of the flow gate collection. Arrow **1024** directs the flow of execution from starting operation **1020** to operation **1026**. Operation

5    **1026** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting an associated AC power transfer on each of the flow gates of the flow gate collection in accordance with certain

10    embodiments.

In certain further embodiments, contracting for an AC power transfer includes other substantial terms besides contracting for the associated AC power transfer for each flow gate of the flow gate collection.

In certain embodiments, contracting for an AC power transfer includes

15    contracting for the associated AC power transfers on each flow gate of the flow gate collection in a written contracting mechanism. Such written mechanisms operate with physically proximate parties in certain further embodiments. In certain alternative further embodiments, physically disparate parties may operate such written mechanisms.

20    In certain other embodiments, contracting for an AC power transfer includes contracting for the associated AC power transfers on each of the flow gates of a flow gate collection in a body-signal based contracting mechanism. In certain further embodiments, contracting for an AC power transfer includes contracting for associated AC power transfers on each flow gate of the flow gate collection in

25    a verbal contracting mechanism.

In certain other further embodiments, contracting for an AC power transfer includes contracting for the associated AC power transfers on each of the flow gates of a flow gate collection in a sign language-based contracting mechanism.

In certain still further embodiments, the sign language-based contracting mechanism may further include additional attributes associated with the body. Such attributes include but are not limited to notes held in the hand, or worn on the body, as well as images triggered on a heads-up display via previous actions of one or more parties.

In certain other embodiments, contracting for an AC power transfer includes contracting for associated AC power transfers on each flow gate of the flow gate collection in a contracting mechanism involving computers. In certain other embodiments, contracting for an AC power transfer includes contracting for the associated AC power transfers on each of the flow gates of a flow gate collection in a contracting mechanism involving computers communicating across a network with other computers.

Note that contracting AC power transfers does not necessitate specification of a time interval for the AC power transfer. A contracting entity investing in an AC power generation facility may receive a perpetual right to some portion of the power generated by that facility. Similarly, a contracting entity investing in an AC power transmission line and/or equipment may receive a perpetual right to some AC power transmission over that component of the AC power network for an indefinitely long period of time.

Figure 5 depicts detail of operation 1004 of Figure 3 when contracting for AC power transfer to take place over a first time interval in accordance with certain embodiments.

Arrow 1040 directs the flow of execution from starting operation 1004 to operation 1042. Operation 1042 performs contracting for AC power transfer on the AC power network to take place over a first time interval. Arrow 1044 directs execution from operation 1042 to operation 1046. Operation 1046 terminates the operations of this flowchart.



In certain embodiments, contracting AC power transfers entails such AC power transfers taking place over a first time interval. A simple time interval as used herein possesses a starting time and an ending time and designates the progression of time from the starting time until the ending time. This progression  
5 of time is constructed such that for a first simple time interval having an ending time coinciding with the starting time of a second simple time interval, the first time simple interval does not overlap with the second simple time interval. As used herein, a time interval contains at least one non-overlapping simple time interval.

10 In certain embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

15 In certain embodiments, simple time intervals contain their starting time in their progression of time and do not containing their ending time in their progression of time. In certain alternative embodiments, simple time intervals do not contain their starting time in their progression of time but do contain their ending time in their progression of time.

20 Figure 6 depicts detail of operation **1022** of Figure 4 contracting the associated AC power transfer on each of the flow gates of the flow gate collection to take place over at least the first time interval in accordance with certain embodiments.

25 Arrow **1060** directs the flow of execution from starting operation **1022** to operation **1062**. Operation **1062** performs contracting the associated AC power transfer on each of the flow gates of the flow gate collection to take place over at least the first time interval. Arrow **1064** directs execution from operation **1062** to operation **1066**. Operation **1066** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one

computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

Figure 7 depicts a flowchart contracting an AC power transfer collection of at least two AC power transfers on an AC power network in accordance with certain  
5 embodiments.

Operation **1080** starts the operations of this flowchart. Arrow **1082** directs the flow of execution from operation **1080** to operation **1084**. Operation **1084** performs contracting an AC power transfer collection of at least two AC power transfers on an AC power network. Arrow **1086** directs execution from operation  
10 **1084** to operation **1088**. Operation **1088** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC  
15 power network with a flow gate collection.

Figure 8 depicts a detail flowchart of operation **1084** of Figure 7 performing contracting a sum of the associated AC power transfer for each of the AC power transfers of the AC power transfer collection on each of the flow gates of the flow gate collection in accordance with certain embodiments.

20 Arrow **1100** directs the flow of execution from starting operation **1084** to operation **1102**. Operation **1102** performs contracting a sum of the associated AC power transfer for each of the AC power transfers of the AC power transfer collection on each of the flow gates of the flow gate collection. Arrow **1104** directs execution from operation **1102** to operation **1106**. Operation **1106**  
25 terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one

computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

Note that in certain embodiments, each flow gate of the flow gate collection has an associated maximum safe carrying capacity.

5 Figure 9 depicts a detail flowchart of operation **1102** of Figure 8 performing the sum of the associated AC power transfer for each AC power transfer of the AC power transfer collection satisfying the associated maximum safe carrying capacity on each flow gate of the flow gate collection in accordance with certain embodiments.

10 Arrow **1120** directs the flow of execution from starting operation **1102** to operation **1122**. Operation **1122** performs the sum of the associated AC power transfer for each AC power transfer of the AC power transfer collection satisfying the associated maximum safe carrying capacity on each flow gate of the flow gate collection. Arrow **1124** directs execution from operation **1122** to operation  
15 **1126**. Operation **1126** terminates the operations of this flowchart.

In certain embodiments, satisfying the maximum safe carrying capacity is automatically performed based upon an initial auction of AC power transfer trading rights by each flow gate facility owner. In certain further embodiments, satisfying the maximum safe carrying capacity is automatically performed by  
20 further contracting countervailing AC power transfers to insure that the sum of associated AC power transfers on each flow gate satisfies the maximum safe carrying capacity of the flow gate.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one  
25 computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

Note that in certain embodiments, each of the AC power transfers of the AC power transfer collection is to take place over a first time interval.

Figure 10 depicts a detail flowchart of operation 1102 of Figure 8 performing contracting each sum of associated AC power transfer for each AC power transfer of the AC power transfer collection to take place at least over the first time interval in accordance with certain embodiments.

Arrow 1140 directs the flow of execution from starting operation 1102 to operation 1142. Operation 1142 performs contracting each of the sum of the associated AC power transfers for each of the AC power transfers of the AC power transfer collection to take place at least over the first time interval. Arrow 1144 directs execution from operation 1142 to operation 1146. Operation 1146 terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

In certain embodiments, each of the AC power transfers of the AC power transfer collection has an associated amount of energy from an associated first node of the AC power network to a second node of the AC power network.

Figure 11 depicts a detail flowchart of operation 1102 of Figure 8 performing contracting an amount of energy of the associated AC power transfer on each of the flow gates of the flow gate collection as essentially an associated linear, skew-symmetric function of the associated amount of energy from the associated first node to the associated second node in accordance with certain embodiments.

Arrow 1160 directs the flow of execution from starting operation 1102 to operation 1162. Operation 1162 performs contracting an amount of energy of

the associated AC power transfer on each of the flow gates of the flow gate collection as essentially an associated linear, skew-symmetric function of the associated amount of energy from the associated first node to the associated second node. Arrow **1164** directs execution from operation **1162** to operation

5 **1166**. Operation **1166** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

10 Note that in certain embodiments, each flow gate of a flow gate collection of an AC power network may be a significant flow gate. In certain embodiments, each significant flow gate of an AC power network is a member of the flow gate collection. Note that in certain embodiments, a flow gate may be included in an AC power network flow gate collection which is not a significant flow gate.

15 Situations where this may occur include but are not limited to situations where a portion of the transmission lines or support equipment, such as transformers, may be damaged and be temporarily disconnected from the AC power network. Additionally, some transmission line may be vital to a regionally determined priority, and may, for regional operating policy reasons, be included in the flow gate collection while not being strictly a significant flow gate. Further,  
20 additionally, a flow gate collection may be determined by regional operating policy, which may utilize different criteria than those described herein, but which provide the automatic handling of congestion through the trading of transmission rights for a collection of flow gates.

25 Figure **12** depicts a detail of operation **1004** of Figure **3** contracting for the AC power transfer on the AC power network to create an agreed contract by a first party to own AC power transfer trading rights and enabling those rights to be further contracted in accordance with certain embodiments.

Arrow **1180** directs the flow of execution from starting operation **1004** to operation **1182**. Operation **1182** performs contracting for the AC power transfer on the AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow gates of the flow gate collection. Arrow **1184** directs execution from operation **1182** to operation **1186**. Operation **1186** performs enabling the first party to further contract to sell the first party owned AC power transfer trading rights. Arrow **1188** directs execution from operation **1186** to operation **1190**. Operation **1190** terminates the operations of this flowchart.

10 In certain other embodiments, these operations are supported by at least one program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection. Note that in certain embodiments, these operations may be performed by distinct program code segments involving distinct execution or inferential language structures.

In certain embodiments, each of the flow gates of the flow gate collection has an associated maximum safe carrying capacity.

Figure **13** depicts a flowchart scheduling the AC power transfer on the AC power network with the flow gate collection in accordance with certain embodiments.

20 Operation **1210** starts the operations of this flowchart. Arrow **1212** directs the flow of execution from operation **1210** to operation **1214**. Operation **1214** performs determining whether the associated AC power transfer of the flow gate of the flow gate collection satisfies the associated maximum safe carrying capacity of the flow gate for each of the flow gates of the flow gate collection.

25 Arrow **1216** directs execution from operation **1214** to operation **1218**. Operation **1218** performs approving the AC power transfer whenever the associated AC power transfer of the flow gate satisfies the maximum safe carrying capacity for each of the flow gates of the flow gate collection. Arrow **1220** directs execution

from operation **1218** to operation **1222**. Operation **1222** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by at least one program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection. Note that in certain embodiments, these operations may be performed by distinct program code segments involving distinct execution or inferential language structures.

Figure **14** depicts a detail flowchart of operation **1186** of Figure **12** performing enabling the first party to further contract to sell the first party owned AC power transfer trading rights before scheduling the AC power transfer for the agreed contract.

Arrow **1230** directs the flow of execution from starting operation **1186** to operation **1232**. Operation **1232** performs enabling the first party to further contract to sell the first party owned AC power transfer trading rights before scheduling the AC power transfer for the agreed contract. Arrow **1234** directs execution from operation **1232** to operation **1236**. Operation **1236** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

In certain embodiments, the agreed contract by the first party to own the AC power transfer trading rights with the associated AC power transfers on a first of the flow gates of the flow gate collection is to take place over a first time interval.

Figure 15 depicts a detail flowchart of operation 1210 of Figure 13 performing scheduling of the AC power transfer for the agreed contract occurring before the first time interval.

5 Arrow 1250 directs the flow of execution from starting operation 1210 to operation 1252. Operation 1252 performs scheduling the AC power transfer for the agreed contract occurring before the first time interval. Arrow 1254 directs execution from operation 1252 to operation 1256. Operation 1256 terminates the operations of this flowchart.

10 In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

15 Figure 16 depicts a detail flowchart of operation 1214 of Figure 13 performing determining whether the associated AC power transfer of the flow gate of the flow gate collection satisfies the associated maximum safe carrying capacity of the flow gate for each of the flow gates of the flow gate collection over the first time interval.

20 Arrow 1270 directs the flow of execution from starting operation 1214 to operation 1272. Operation 1272 performs determining whether the associated AC power transfer of the flow gate of the flow gate collection satisfies the associated maximum safe carrying capacity of the flow gate for each of the flow gates of the flow gate collection over the first time interval. Arrow 1274 directs execution from operation 1272 to operation 1276. Operation 1276 terminates the operations of this flowchart.

25 In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection. In certain further embodiments, these



operations are embedded in a time triggered program code segment which performs operation **1210**, scheduling the AC power transfer before the first time interval.

5 Figure **17** depicts a detail flowchart of operation **1218** of Figure **13** performing approving the AC power transfer over the first time interval whenever the associated AC power transfer of the flow gate satisfies the maximum safe carrying capacity for each the flow gates of the flow gate collection over the first time interval.

10 Arrow **1290** directs the flow of execution from starting operation **1218** to operation **1292**. Operation **1292** performs approving the AC power transfer over the first time interval whenever the associated AC power transfer of the flow gate satisfies the maximum safe carrying capacity for each the flow gates of the flow gate collection over the first time interval. Arrow **1294** directs execution from operation **1292** to operation **1296**. Operation **1296** terminates the operations of  
15 this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

20 Figure **18** depicts a flowchart performing contracting for an AC power transfer collection of at least one AC power transfer to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow gates of the flow gate collection.

Operation **1310** starts the operations of this flowchart. Arrow **1312** directs the  
25 flow of execution from operation **1310** to operation **1314**. Operation **1314** performs contracting for an AC power transfer collection of at least one AC power transfer to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow

gates of the flow gate collection. Arrow **1316** directs execution from operation **1314** to operation **1318**. Operation **1318** terminates the operations of this flowchart.

5 In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

Figure **19** depicts a detail flowchart of operation **1314** of Figure **18** performing contracting for a sum of associated AC power transfers for all AC power transfers of the AC power transfer collection to create a contract for an associated AC power transfer for the collection of AC power transfers for each of the flow gates of the flow gate collection.

Arrow **1330** directs the flow of execution from starting operation **1314** to operation **1332**. Operation **1332** performs contracting for a sum of associated AC power transfers for all AC power transfers of the AC power transfer collection to create a contract for an associated AC power transfer for the collection of AC power transfers for each of the flow gates of the flow gate collection. Arrow **1334** directs execution from operation **1332** to operation **1336**. Operation **1336** terminates the operations of this flowchart.

20 In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

In certain embodiments, each of the AC power transfers of the AC power transfer collection has an associated amount of energy from an associated first node of the AC power network to the second node of the AC power network.

Figure 20 depicts a detail flowchart of operation 1332 of Figure 19 performing calculating the associated AC power transfer on the flow gate of the AC power transfer as an amount of energy which is an essentially linear, skew-symmetric associated function of the amount of energy of the AC power transfer from the associated first node of the AC power transfer to the associated second node of the AC power transfer of each of the flow gates of the flow gate collection.

Arrow 1350 directs the flow of execution from starting operation 1332 to operation 1352. Operation 1352 performs calculating the associated AC power transfer on the flow gate of the AC power transfer as an amount of energy which is an essentially linear, skew-symmetric associated function of the amount of energy of the AC power transfer from the associated first node of the AC power transfer to the associated second node of the AC power transfer of each of the flow gates of the flow gate collection. Arrow 1354 directs execution from operation 1352 to operation 1356. Operation 1356 terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

Figure 21 depicts a detail flowchart of operation 1186 of Figure 12 performing enabling the first party to further contract to sell the first party owned AC power transfer trading rights for the associated AC power transfer for a first of the flow gates of the flow gate collection.

Arrow 1370 directs the flow of execution from starting operation 1186 to operation 1372. Operation 1372 performs enabling the first party to further contract to sell the first party owned AC power transfer trading rights for the associated AC power transfer for a first of the flow gates of the flow gate

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collection. Arrow **1374** directs execution from operation **1372** to operation **1376**. Operation **1376** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

Figure **22** depicts a detail flowchart of operation **1186** of Figure **12** performing enabling the first party to further contract to sell the first party owned AC power transfer trading rights for the associated AC power transfer for each of the flow gates of the flow gate collection.

Arrow **1390** directs the flow of execution from starting operation **1186** to operation **1392**. Operation **1392** performs enabling the first party to further contract to sell the first party owned AC power transfer trading rights for the associated AC power transfer for each of the flow gates of the flow gate collection. Arrow **1394** directs execution from operation **1392** to operation **1396**. Operation **1396** terminates the operations of this flowchart.

In certain other embodiments, these operations are supported by a program code segment residing in a coupled computer readable memory on at least one computer in a computing system for contracting AC power transfers on an AC power network with a flow gate collection.

In certain embodiments, the first party may be a human being. In certain other embodiments, the first party may be a corporate entity. In certain further embodiments, the corporate entity may be a corporation. In certain other further embodiments, the corporate entity may be a form of partnership.

In certain other embodiments, the first party is represented by an agent authorized by the first party to act on behalf of the first party with respect to

contracting AC power transfer. In certain further embodiments, the agent may be a software agent executing on a software agent computer.

Figure 23 depicts a simplified system block of a computing system 2000 supporting contracting AC power transfer on an AC power network with a flow gate collection in accordance with certain embodiments.

Computing system 2000 is comprised of at least one computer 2020 coupled 2024 to computer readable memory 2026. The communication and interaction between computing system 2000 and computer 2020 is denoted by arrow 2022. Such communication and interaction 2022 may employ a variety of communications technologies, including a wireless physical transport layer in certain embodiments. In certain alternative embodiments, communication and interaction 2022 may employ a wireline physical transport layer.

Figure 24 depicts a refinement of computing system 2000 as a system diagram in Figure 23 in accordance with certain further embodiments. This computing system is comprised of a client computer collection and a server system 2500 coupled to a network 2200.

The client computer collection is comprised of at least one client computer 2600 operated 2192 by client 2190. In certain further embodiments, client computer 2610 operated 2104 by a human being as client 2100. In certain other further embodiments, client computer 2620 operated 2124 by a corporate entity as client 2120. In certain other further embodiments, client computer 2630 operated 2144 by an authorized agent as client 2140. The first party is represented by an agent authorized by the first party to act on behalf of the first party with respect to contracting the AC power transfer.

Server system 2500 includes at least one server computer 2520 coupled to network 2200. Network 2200 further couples 2602, 2612, 2622, 2632 and 2642 to client computers 2600, 2610, 2620, 2630 and 2640, respectively. Network

**2200** at least supports communication between client computers and at least one server computer **2520** of server system **2500**. As used herein, the term network refers not only to Local Area Networks (LANs), but also to Wide Area Networks (WANs). Network supported communication as used herein includes, but is not limited to, digital communication protocols as well as analog communication protocols. Network supported communication as used herein further includes, but is not limited to, message passing protocols and packet based protocols. Network supported communication as used herein further includes, but is not limited to, communication protocols including TCP/IP.

10 Network supported communication as used herein further includes, but is not limited to, communication protocols supporting the Internet. Network supported communication as used herein further includes, but is not limited to, communication protocols supporting the World Wide Web.

In certain further embodiments, the client computer collection is comprised of at least one client computer **2600** with coupled **2604** computer readable memory **2606** operated **2192** by client **2190**. In certain further embodiments, client computer **2610** with coupled **2614** computer readable memory **2616** is operated **2104** by a human being as client **2100**. In certain other further embodiments, client computer **2620** with coupled **2624** computer readable memory **2626**

20 operated **2124** by a corporate entity as client **2120**. In certain other further embodiments, client computer **2630** with coupled **2634** computer readable memory **2636** operated **2144** by an authorized agent as client **2140**.

In certain further embodiments, client computer **2610** with coupled **2614** computer readable memory **2616** operated **2104** by a client **2100** further coupled **2194** to computer readable memory **2606**. In certain further embodiments, client computer **2640** with coupled **2644** computer readable memory **2646** operated **2164** by a software agent as client **2160**. In certain other further embodiments, the coupling **2194** provides various personal optimizations and shortcuts,

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including but not limited to macro style functions and standard contract forms employed by the client **2190**.

In certain other further embodiments, server system **2500** includes at least one server computer **2520** coupled **2524** to computer readable memory **2526**.

- 5 Figure **25A** depicts a detail flowchart of operation **1000** of Figure **3** performing identifying a first of the clients operating a first of the client computers as the first party.

Arrow **1410** directs the flow of execution from starting operation **1000** to operation **1412**. Operation **1412** performs identifying a first of the clients  
10 operating a first of the client computers as the first party. Arrow **1414** directs execution from operation **1412** to operation **1416**. Operation **1416** terminates the operations of this flowchart.

Figure **25B** depicts a flowchart of the first client user operating the first client computer as the first party.

- 15 Operation **1430** starts the operations of this flowchart. Arrow **1432** directs the flow of execution from operation **1430** to operation **1434**. Operation **1434** performs the first client user operating the first client computer as the first party. Arrow **1436** directs execution from operation **1434** to operation **1438**. Operation **1438** terminates the operations of this flowchart.

- 20 Figure **26** depicts a detail flowchart of operation **1434** of Figure **25B** performing operations related to first client stimulus, response and network communication with a first server computer of the server system.

Arrow **1450** directs the flow of execution from starting operation **1434** to operation **1452**. Operation **1452** performs receiving stimulus from the first user  
25 to create a received stimulus stream. Arrow **1454** directs execution from operation **1452** to operation **1456**. Operation **1456** performs communicating via

the network with the first server computer to create a received server stream and to create a server delivery stream. Arrow **1458** directs execution from operation **1456** to operation **1460**. Operation **1460** performs displaying a status based upon the received stimulus stream and the received server stream. Arrow **1462** directs execution from operation **1460** to operation **1464**. Operation **1464** terminates the operations of this flowchart.

Figure **27** depicts a detail flowchart of operation **1004** of Figure **3** performing communicating via the network with the first client computer to create a received server delivery stream.

Arrow **1490** directs the flow of execution from starting operation **1004** to operation **1492**. Operation **1492** performs communicating via the network with the first client computer to create a received server delivery stream. Arrow **1494** directs execution from operation **1492** to operation **1496**. Operation **1496** terminates the operations of this flowchart.

Figure **28** depicts a virtual trading floor **3000**, containing validated orders and market intervals with associated market states in accordance with certain embodiments.

A virtual trading floor mechanism **3000** comprises a collection of market intervals, each with an associated market state, and validated orders from certified clients. A market contains a product type and a location. Trading in the market is done in terms of market intervals **3100**, **3120**, **3140** and **3160**. Each market interval of a market contains the market product type, market location, plus a calendar scheme with an interval end. The market state of a market interval comprises a market price for the product type at the location during the calendar scheme with interval end.



Figure 29 depicts a detail flowchart of operation 1004 of Figure 3 performing supporting operating a virtual trading floor containing a market interval for trading AC power transfer for each of the flow gates of the flow gate collection.

5 Arrow 1510 directs the flow of execution from starting operation 1004 to operation 1512. Operation 1512 performs operating a virtual trading floor containing a market interval for trading AC power transfer for each of the flow gates of the flow gate collection. Arrow 1514 directs execution from operation 1512 to operation 1516. Operation 1516 performs operating a virtual trading floor at least one market interval for trading AC power transfer for each of the  
10 flow gates of the flow gate collection. Arrow 1518 directs execution from operation 1516 to operation 1520. Operation 1520 terminates the operations of this flowchart.

Note that in certain further embodiments, a virtual trading floor may support contracting of AC energy in an AC power network as markets. In certain further  
15 embodiments, an ancillary energy service may be supported as a market. Ancillary energy services are typically defined within a regulatory region, such as an RTO (Regional Transmission Organization). By way of example, in California, such ancillary services provide AC power network operators with energy and transmission reserves to effect real-time balancing of the AC power network, and  
20 possibly the grid the AC power network belongs to. These networks may be controlled and maintained to remain within its operational parameters, such as voltage, frequency, phase stability and maximum safe carrying capacity. Examples of such ancillary markets in California include Spinning reserve, Non-spinning reserve, Black Start and Replacement Reserve.

25 Such ancillary services are treated as markets with an additional primary parameter. When contracting for ancillary energy services, operators pay for the right to call on an amount of power(energy), as well as pay for the energy at the agreed price. The facility reserves the power output of the ancillary service contract based upon the agreed fees paid for right to call on that power output.

The facility then generates a portion or all of that power output, at the operator's direction, based upon the agreed fee for that power production. Such a scheme may be applied to not only power generation but also to power transmission.

In certain further embodiments, a virtual trading floor may support contracting AC power and AC energy transfer in a grid containing at least one AC power network. In certain further embodiments, a virtual trading floor may support contracting of a DC power transfer within a grid as a market. Note that in certain embodiments, a grid may include at least two AC power networks.

Figure 30 depicts a detail flowchart of operation 1512 of Figure 29 performing collecting orders and creating contracts in accordance with certain embodiments.

Arrow 1530 directs the flow of execution from starting operation 1512 to operation 1532. Operation 1532 performs transforming the received server delivery stream into an order collection containing at least one bid order and at least one ask order. Arrow 1534 directs execution from operation 1532 to operation 1536. Operation 1536 performs contracting AC power transfer on the AC power network to create an agreed contract based upon a first of the bid orders of the order collection and based upon a first of the ask orders of the order collection. Arrow 1538 directs execution from operation 1536 to operation 1540. Operation 1540 terminates the operations of this flowchart.

Consider an AC power network with a flow gate collection containing at least one flow gate. In certain embodiments, a virtual trading floor involving markets for the AC power network comprising, for each flow gate of the flow gate collection, a market trading AC energy transfer at a location corresponding to the flow gate. In certain further embodiments, there is at least one active market interval associated with each flow gate of the flow gate collection, where the location is the flow gate location in the AC power network and the product type is AC power transfer. Note that in certain embodiments, the AC power transfer product type

may have a different designation, but be based upon the same physical phenomena for AC power networks.

Validated orders from certified clients comprise bid orders for a specific market interval and ask orders of a specific market interval. A validated order in certain further embodiments may comprise multiple validated orders. A validated order  
 5 in certain further embodiments may comprise multiple validated orders for a specific location and specific product. The bid and ask orders for a given market interval determine at least in part its market price.

In certain embodiments, each of the validated orders of the validated order  
 10 collection belongs to a collection comprising a bid type and an ask type. In certain further embodiments, validated orders form an agreed contract with a bid order essentially matching an ask order in price for the same market interval. Validate orders are active only within a specified window on a calendar line. When real time passes the window of a market interval, the orders are rejected.  
 15 Once agreed, orders are legally binding contracts between the contracting parties of the virtual trading floor for that market interval and can be used to generate commands to cause the product type transaction to occur at the specified location and for the calendar scheme of the closed market interval.

Figure 31 depicts a detail flowchart of operation **1004** of Figure 3 contracting AC  
 20 power transfer based upon a first bid type order of the validated orders of the validated order collection and a first ask type order of the validated orders of the validated order collection.

Arrow **1550** directs the flow of execution from starting operation **1004** to operation **1552**. Operation **1552** performs contracting the AC power transfer on  
 25 the AC power network based upon a first bid type order of the validated orders of the validated order collection and a first ask type order of the validated orders of the validated order collection. Arrow **1554** directs execution from operation **1552** to operation **1556**. Operation **1556** terminates the operations of this flowchart.

Figure 32 depicts a detail flowchart of operation 1182 of Figure 12 performing contracting for the AC power transfer on the AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow gates of the flow gate collection based upon a first bid type order of the validated orders of the validated order collection and a first ask type order of the validated orders of the validated order collection.

Arrow 1570 directs the flow of execution from starting operation 1182 to operation 1572. Operation 1572 performs contracting for the AC power transfer on the AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of the flow gates of the flow gate collection based upon a first bid type order of the validated orders of the validated order collection and a first ask type order of the validated orders of the validated order collection. Arrow 1574 directs execution from operation 1572 to operation 1576. Operation 1576 terminates the operations of this flowchart.

In certain embodiments, process groups are used to provide a redundant, fault tolerant computing mechanism. A process group comprises a collection of identical processes, which perform the same computation at essentially the same time and write the same output to mass storage. To an outside observer, the process group appears as a single entity, even though the actual computation is replicated on several physical computers, which may be far apart from each other. Individual processes within the process group may crash, or new processes may join, but to an outside observer the process group will appear intact. Further, since the output saved to mass storage by all process group members is identical, the process group can survive any individual mass storage failure.

Figure **33A** depicts a flowchart of operations as previously described which collectively are included in the process groups performed on the reliable server system in accordance with certain embodiments.

5 Arrow **1602** directs the flow of execution from starting operation **1600** to operation **1000**. Operation **1000** performs operations discussed regarding Figure 3. Arrow **1606** directs execution from operation **1000** to operation **1608**. Operation **1608** terminates the operations of this flowchart.

10 Arrow **1610** directs the flow of execution from starting operation **1600** to operation **1080**. Operation **1080** performs operations discussed regarding Figure 7. Arrow **1614** directs execution from operation **1080** to operation **1608**. Operation **1608** terminates the operations of this flowchart.

15 Arrow **1620** directs the flow of execution from starting operation **1600** to operation **1210**. Operation **1210** performs operations discussed regarding Figure 13. Arrow **1624** directs execution from operation **1210** to operation **1608**. Operation **1608** terminates the operations of this flowchart.

Arrow **1630** directs the flow of execution from starting operation **1600** to operation **1310**. Operation **1310** performs operations discussed regarding Figure 18. Arrow **1634** directs execution from operation **1310** to operation **1608**. Operation **1608** terminates the operations of this flowchart.

20 Figure **33B** depicts a method of controlling the interaction between a client **2190** and a virtual trading floor comprising maintaining a session component **3300**, participant component **3320** and market segment **3340** in accordance with certain embodiments.

25 In certain further embodiments, maintaining the session component **3300** comprises the following: Receiving an order request message **3302** from client **2190**. Sending the received order request message **3322** to the participant component **3320** to create a forwarded order request message for the participant

component. Receiving **3324** the acknowledgement message based upon the validated order request message and the relevant client list message for the validated order request message. Processing the received acknowledgement message and relevant client list for the validated order request message to  
 5 create a broadcast update message for the validated order request message. Sending the broadcast update message **3304** to each of the clients **2190** of the relevant client list.

In certain further embodiments, maintaining the participant component **3320** comprises the following: Receiving the forwarded order request message **3302**  
 10 from the session component. Maintaining **3332** a participant database **3330**. Validating the received, forwarded order request message. And responding to the validated order request message whenever the received, forwarded order request message is validated.

In certain further embodiments, maintaining the participant database comprises  
 15 the following: Adding the received, forwarded order request message **3332** to the participant database **3330**. Validating the received, forwarded ordered request message requires examining **3324** and **3322** the session database based upon the received, forwarded order request message to create a validated order request message.

In certain further embodiments, responding to a validated message comprises  
 20 the participant component performing the following activities: Sending an acknowledgement message **3324** based upon the validated order request message to the session component **3300**. Assembling a list of relevant clients for the validated order request message and sending **3324** the session component  
 25 **3300** a relevant client list message for the validated order request message. Sending a market order request message **3342** to the market segment **3340** based upon the validated order request message.

In certain further embodiments, maintaining the market segment **3340** comprises performing the following activities: Receiving the market order request message **3342**. Maintaining **3352** a market segment database **3350** comprised of market intervals with associated market states as either active or closed. The market state of an active market interval comprises the total pending buy-position and the total pending sell-position.

In certain further embodiments, maintaining the market segment database **3350** comprises performing the following activities: Updating the market state of at least one market interval **3352** based upon the received market order request message **3342**. Reconciling the total pending buy-position with the total pending sell-position of at least one market interval. Closing a market interval.

In certain further embodiments, a virtual trading mechanism database comprising a read-only database **3360** for market configuration and for participant configuration by the virtual trading mechanism. In certain embodiments, settlement and schedule databases are not directly accessed by the virtual trading mechanism.

Figure **33C** depicts a refinement of computing system **2000** as a system diagram in Figure **24** in accordance with certain further embodiments. This computing system is comprised of a client computer collection and a server system **2500** coupled to a network **2200**.

As shown in Figure **24**, the client computer collection contains at least one client computer **2600** operated **2192** by client **2190**. In certain further embodiments, client computer **2610** is operated **2104** by a human being as client **2100**. In certain other further embodiments, client computer **2620** is operated **2124** by a corporate entity as client **2120**. In certain other further embodiments, client computer **2630** is operated **2144** by an authorized agent as client **2140**. The first party is represented by an agent authorized by the first party to act on behalf of the first party with respect to contracting the AC power transfer.

As shown in Figure 24, server system 2500 includes a server computer 2520 coupled 2528 to network 2200. In certain further embodiments, server system 2500 includes server computer 2530 coupled 2538 to network 2200. In certain further embodiments, server system 2500 includes server computer 2540 coupled 2548 to network 2200. In certain further embodiments, server system 2500 includes server computer 2550 coupled 2558 to network 2200. Note that in other further embodiments, even more server computers may be coupled to the network.

As shown in Figure 24, network 2200 further couples 2602, 2612, 2622, 2632 and 2642 to client computers 2600, 2610, 2620, 2630 and 2640, respectively. Network 2200 at least supports communication between client computers and at least one server computer 2520 of server system 2500. As used herein, the term network refers not only to Local Area Networks (LANs), but also to Wide Area Networks (WANs). Network supported communication as used herein includes, but is not limited to, digital communications protocols as well as analog communication protocols. Network supported communication as used herein further includes, but is not limited to, message passing protocols and packet based protocols. Network supported communication as used herein further includes, but is not limited to, communication protocols including TCP/IP. Network supported communication as used herein further includes, but is not limited to, communication protocols supporting the Internet. Network supported communication as used herein further includes, but is not limited to, communications protocols supporting the World Wide Web.

As shown in Figure 24, in certain further embodiments, the client computer collection is comprised of at least one client computer 2600 with coupled 2604 computer readable memory 2606 is operated 2192 by client 2190. In certain further embodiments, client computer 2610 with coupled 2614 computer readable memory 2616 is operated 2104 by a human being as client 2100. In certain other further embodiments, client computer 2620 with coupled 2624



computer readable memory **2626** is operated **2124** by a corporate entity as client **2120**. In certain other further embodiments, client computer **2630** with coupled **2634** computer readable memory **2636** is operated **2144** by an authorized agent as client **2140**.

- 5 As shown in Figure 24, in certain further embodiments, client computer **2610** with coupled **2614** computer readable memory **2616** is operated **2104** by a client **2100** further coupled **2194** to computer readable memory **2606**. In certain further embodiments, client computer **2640** with coupled **2644** computer readable memory **2646** is operated **2164** by a software agent as client **2160**. In  
10 certain other further embodiments, the coupling **2194** provides various personal optimizations and shortcuts, including but not limited to macro style functions and standard contract forms employed by the client **2190**.

- As shown in Figure 24, in certain other further embodiments, server system **2500** includes at least one server computer **2520** coupled **2524** to computer readable  
15 memory **2526**. Additionally, in certain further embodiments, server system **2500** includes server computer **2530** coupled **2534** to computer readable memory **2536**. Additionally, in certain further embodiments, server system **2500** includes server computer **2540** coupled **2544** to computer readable memory **2546**. Additionally, in certain further embodiments, server system **2500** includes server  
20 computer **2550** coupled **2554** to computer readable memory **2556**.

- Note that in certain further embodiments, server computer coupled computer readable memory may contain a read-write accessible memory. Note that in certain further embodiments, the read-write accessible memory may contain at least one mass storage unit. In certain further embodiments, a mass storage  
25 unit may include a disk drive. In certain embodiments, a mass storage unit may be accessed using a file management system. In certain embodiments, a mass storage unit may be accessed as a database.

Certain embodiments include a method of operating a client computer with a client computer message address interfaced with a reliable distributed system composed of a server system containing server computers with associated messaging addresses. The method includes a login procedure, a message  
5 composition procedure for an outgoing message to the reliable distributed system, and a message analysis procedure for an incoming message from the reliable distributed system.

In certain further embodiments, the login procedure maintains a list of messaging addresses of the collection of computers of the distributed system, a first login  
10 message and a login protocol and performs the following:

- a. A first server computer of the server system is selected, and a first login message is sent to the associated address of the first server computer.
- b. If there is a first acknowledgement message received from the first server  
15 computer message address then the login procedure proceeds to perform the login protocol.
- c. Whenever the login protocol fails with the first server computer or
  - whenever there is no acknowledgement message received from the first server computer within a predetermined amount of time or
  - whenever there remain server computers in the server system for  
20 which login has not been attempted,
  - the first server computer is selected from the remaining server computers of the server system and these steps are repeated.
- d. Whenever the login protocol succeeds with the first server computer, the first server computer is designated the connection computer.

25 In certain further embodiments, the message composition procedure for an outgoing message to the distributed system comprises performing the following: Maintaining a list of message formats. Determining the selection of a first message format. Using the first message format to create an outbound message. Sending the outbound message to the connection computer.

In certain further embodiments, the message analysis procedure for an incoming message from the distributed system comprises performing the following: Receiving the message from the connection computer. Validating the received message creates a valid received message.

- 5 Certain embodiments employ an object class structure supporting message passing, each message comprises a message type and at least one message field. Each message-passing object comprises handling an unknown message type and handling for an unknown message field.

- 10 In certain further embodiments, handling an unknown message type for a received message from a first object by a second object comprises the first object sending the second object a reply message indicating unknown received message type and referencing the received message.

- 15 In certain further embodiments, handling an unknown message field of the received message by the second object comprises handling the other fields of the received message by the second object.

- 20 Certain embodiments employ a method of operating a reliable distributed system of a collection containing at least one process group running on several computers comprising receiving confirmed messages from certified clients and maintaining a group state. Each process group computer possesses a messaging address. The computers of a process group communicate amongst themselves with a virtually synchronous messaging system.

- 25 In certain further embodiments, receiving a confirmed message from a certified client occurs at one computer of the first collection of computers running the process group. Upon receipt the receiving computer broadcasts the confirmed message from the certified client to all computers of the first collection of computers.

In certain further embodiments, maintaining a group state on each computer of the first collection of computers of the process group comprising the following operations: Each computer processes the confirmed message from the certified client to create a group state candidate. Each computer broadcasting a virtually synchronous group state candidate message to the other computers. Each computer receives the virtually synchronous group state candidate messages of the other computers. Each computer analyzes the received virtually synchronous group state candidate messages and its own virtually synchronous group state candidate to create a new group state.

- 10 Certain embodiments employ a messaging system for message passing concurrent objects, instances of which reside on computers each possessing a controller belonging to a collection of computers comprising ABCAST protocol and GBCAST protocol. The ABCAST protocol is an atomic broadcast protocol used to communicate messages between object instances across the computers of the collection of computers. The GBCAST protocol is a global broadcast protocol to communicate messages between controllers of the computers of the collection of computers.

20 Certain embodiments employ an object class structure executing in a process group of computers communicating with each other via a messaging protocol supporting at least virtual synchrony. Each instance of each object of the object class structure comprises an object instance clone reading on each of the process group computers.

25 In certain further embodiments, each object instance may send and receive messages from other object instances and each object instance clone communicates with messages to other object instance clones of the same object instance.

In certain further embodiments, each object class possesses a state, which is member of a collection of states. Each instance of each object class state

changes as an atomic event. All activities of each object class occur as atomic events. Atomic events may be triggered by message reception. State changes in an object instance clone trigger transmission of a state change message to other object instance clones of the same object instance.

- 5 In certain embodiments, a concurrent computing entity resides on each of the computers of a process group of computers where it owns access to a binary file used for storing the resilient object instance state. It executes updates to the binary file as a transaction. The storage in the binary file is organized into table objects. Each table object consists of a set of records.

- 10 Figure 34 depicts a view of a certified client user interface operating on a client computer showing an ordering screen with hourly time interval based market intervals for a specific energy market in accordance with certain embodiments.

- Figure 35 depicts a view of a certified client user interface operating on a client computer showing an ordering screen for daily on-peak time interval based market intervals for a specific energy market in accordance with certain  
15 embodiments.

Figure 36 depicts a view of a certified client user interface operating on a client computer showing an ordering screen for hourly time interval based market intervals for a specific flow gate market in accordance with certain embodiments.

- 20 The displayed information 4200 includes a variety of fields, including field 4202, where a specific flow gate or intertie may be selected. Immediately below that field is a field which specifies commodity type, in this case, "Hourly Flowgate". The column indicated by 4204 represents the current market price. The column to its right indicates the amount of the commodity which has been awarded. The  
25 box 4206 points to two columnar components. The left component represents the auction bid quantity and the right component represents the bid price per unit quantity on each row. Note that each row represents a distinct market interval, trading independently of the other market intervals.



Claims

1. A method for contracting AC power transfer on an AC power network with a flow gate collection containing at least one flow gate comprising:

contracting an AC power transfer on said AC power network comprising;

5 contracting an associated AC power transfer on each of said flow gates of said flow gate collection.

2. The method of Claim 1,

wherein contracting for AC power transfer on said AC power network comprises:

10 contracting for AC power transfer on said AC power network to take place over a first time interval; and

wherein contracting said associated AC power transfer on each of said flow gates of said flow gate collection comprises;

15 contracting said associated AC power transfer on each of said flow gates of said flow gate collection to take place over at least said first time interval.

3. The method of Claim 2, further comprising:

contracting an AC power transfer collection of at least two AC power transfers on an AC power network further comprises;

20 contracting a sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection on each of said flow gates of said flow gate collection.

4. The method of Claim 3,

wherein each flow gate of said flow gate collection has an associated maximum safe carrying capacity; and

25 wherein contracting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection on each of said flow gates of said flow gate collection comprises;

said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection satisfying said associated maximum safe carrying capacity on each of said flow gates of said flow gate collection.

5 5. The method of Claim 3,

wherein each of said AC power transfers of said AC power transfer collection is to take place over a first time interval; and

wherein contracting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection on each of  
10 said flow gates of said flow gate collection comprises;

contracting each of said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection to take place at least over said first time interval.

15 6. The method of Claim 3,

wherein each of said AC power transfers of said AC power transfer collection has an associated amount of energy from an associated first node of said AC power network to a second node of said AC power network; and

further contracting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection on each of said  
20 flow gates of said flow gate collection comprises;

contracting an amount of energy of said associated AC power transfer on each of said flow gates of said flow gate collection as essentially an associated linear, skew-symmetric function of said associated amount of energy from said associated first node to said associated second node.

25 7. The method of Claim 1,

wherein each of said flow gates of said flow gate collection is a significant flow gate of said AC power network.

8. The method of Claim 1,



wherein each significant flow gate of said AC power network is a flow gate in said flow gate collection.

9. The method of Claim 1,

wherein contracting for said AC power transfer on said AC power network  
5 comprises;

contracting for said AC power transfer on said AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection; and

10 enabling said first party to further contract to sell said first party owned AC power transfer trading rights.

10. The method of Claim 9,

wherein each of said flow gates of said flow gate collection has an associated maximum safe carrying capacity; and

15 further comprising scheduling said AC power transfer for said agreed contract comprising:

determining whether said associated AC power transfer of said flow gate of said flow gate collection satisfies said associated maximum safe carrying capacity of said flow gate for each of said flow gates of said flow gate collection;

20 and

approving said AC power transfer whenever said associated AC power transfer of said flow gate satisfies said maximum safe carrying capacity for each said flow gates of said flow gate collection.

11. The method of Claim 10,

25 wherein enabling said first party to further contract to sell said first party owned AC power transfer trading rights comprises;

enabling said first party to further contract to sell said first party owned AC power transfer trading rights before scheduling said AC power transfer for said agreed contract.

12. The method of Claim 10,

wherein said agreed contract by said first party to own said AC power transfer trading rights with said associated AC power transfers on a first of said flow gates of said flow gate collection is to take place over a first time interval;

5 and

wherein scheduling said AC power transfer for said agreed contract further comprises:

scheduling said AC power transfer for said agreed contract occurs before said first time interval.

10 13. The method of Claim 12,

wherein determining whether said associated AC power transfer of said flow gate of said flow gate collection satisfies said associated maximum safe carrying capacity of said flow gate for each of said flow gates of said flow gate collection further comprises;

15 determining whether said associated AC power transfer of said flow gate of said flow gate collection satisfies said associated maximum safe carrying capacity of said flow gate for each of said flow gates of said flow gate collection over said first time interval; and

20 wherein approving said AC power transfer whenever said associated AC power transfer of said flow gate satisfies said maximum safe carrying capacity for each said flow gate of said flow gate collection further comprises;

25 approving said AC power transfer over said first time interval whenever said associated AC power transfer of said flow gate satisfies said maximum safe carrying capacity for each said flow gates of said flow gate collection over said first time interval.

14. The method of Claim 13, further comprising:

contracting for an AC power transfer collection of at least one AC power transfer to create an agreed contract by a first party to own AC power transfer

trading rights with associated AC power transfers on each of said flow gates of said flow gate collection further comprises;

contracting for a sum of associated AC power transfers for all AC power transfers of said AC power transfer collection to create a contract for an associated AC power transfer for said collection of AC power transfers for each  
5 of said flow gates of said flow gate collection.

15. The method of Claim 14, further comprising:

wherein each of said AC power transfers of said AC power transfer collection has an associated amount of energy from an associated first node of said AC power network to said second node of said AC power network;  
10

wherein contracting for a sum of associated AC power transfers for all AC power transfers of said AC power transfer collection to create a contract for an associated AC power transfer for said collection of AC power transfers for each of said flow gates of said flow gate collection comprises;

15 calculating said associated AC power transfer on said flow gate of said AC power transfer as an amount of energy which is an essentially linear, skew-symmetric associated function of said amount of energy of said AC power transfer from said associated first node of said AC power transfer to said associated second node of said AC power transfer of each of said flow gates of  
20 said flow gate collection.

16. The method of Claim 9, further comprising:

wherein enabling said first party to further contract to sell said first party owned AC power transfer trading rights further comprises;

enabling said first party to further contract to sell said first party owned AC power transfer trading rights for said associated AC power transfer for a first of  
25 said flow gates of said flow gate collection.

17. The method of Claim 16, further comprising:

wherein enabling said first party to further contract to sell said first party owned AC power transfer trading rights further comprises;

enabling said first party to further contract to sell said first party owned AC power transfer trading rights for said associated AC power transfer for each of said flow gates of said flow gate collection.

18. The method of Claim 9,  
5 wherein said first party is a human being.
19. The method of Claim 18,  
wherein said first party is a corporate entity.
20. The method of Claim 19,  
wherein said first party is represented by an agent authorized by said first  
10 party to act on behalf of said first party with respect to contracting AC power transfer.
21. The method of Claim 20,  
wherein said agent is a software agent executing on a computer.
22. The method of Claim 1,  
15 wherein said computing system is comprised of  
a client computer collection containing at least one client computer  
operated by a client;  
a server system containing at least one server computer; and  
a network coupling said client computer of said client computer collection  
20 and coupling at least a first of said server computers of said server system; and  
wherein contracting said AC power transfer on said AC power network  
further comprises  
identifying a first of said clients operating a first of said client computers as  
said first party.
23. The method of Claim 22, further comprising:  
25

a first client user operating said first client computer as said first party residing on said computer readable memory coupled to said first client computer comprising;

receiving a stimulus from said first user to create a received stimulus stream;

communicating via said network with said first server computer to create a received server stream and to create a server delivery stream; and

displaying an interactive status based upon said received stimulus stream and said received server stream; and

wherein contracting said AC power transfer on said AC power network further comprises

communicating via said network with said first client computer to create a received server delivery stream.

24. The method of Claim 23,

wherein contracting AC power transfer on said AC power network further comprises;

operating a virtual trading floor containing a market for trading AC power transfer for each of said flow gates of said flow gate collection further comprising

transforming said received server delivery stream into an order collection containing at least one bid order and at least one ask order; and

contracting AC power transfer on said AC power network to create an agreed contract based upon a first of said bid orders of said order collection and based upon a first of said ask orders of said order collection.

25. A program operating system executing on a computing system comprised of at least one computer, each of said computers in said computing system coupled to an associated computer readable memory, supporting with program code segments contracting AC power transfer on an AC power network with a flow gate collection containing at least one flow gate, comprising:

a program code segment supporting contracting an AC power transfer on said AC power network comprising;

a program code segment supporting contracting an associated AC power transfer on each of said flow gates of said flow gate collection.

5 26. The program operating system of Claim 25,

wherein said program code segment supporting contracting an AC power transfer on said AC power network comprises;

a program code segment supporting contracting an AC power transfer on said AC power network to take place over a first time interval; and

10 wherein said program code segment supporting contracting said associated AC power transfer on each of said flow gates of said flow gate collection comprises;

15 a program code segment supporting contracting said associated AC power transfer on each of said flow gates of said flow gate collection to take place over at least said first time interval.

27. The program operating system of Claim 26, further comprising:

a program code segment supporting contracting an AC power transfer collection of at least two AC power transfers on an AC power network further comprises

20 a program code segment supporting contracting a sum of said associated AC power transfers for each of said AC power transfers of said AC power transfer collection on each of said flow gates of said flow gate collection.

28. The program operating system of Claim 27,

25 wherein each flow gate of said flow gate collection has an associated maximum safe carrying capacity; and

wherein said program code segment supporting contracting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection on each of said flow gates of said flow gate collection comprises;

a program code segment supporting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection satisfying said associated maximum safe carrying capacity on each of said flow gates of said flow gate collection.

5 29. The program operating system of Claim 27,

wherein each of said AC power transfers of said AC power transfer collection is to take place over a first time interval; and

wherein said program code segment supporting contracting said sum of said associated AC power transfer for each of said AC power transfers of said  
10 AC power transfer collection on each of said flow gates of said flow gate collection comprises;

a program code segment supporting contracting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection to take place at least over at least said first time interval  
15 on each of said flow gates of said flow gate collection.

30. The program operating system of Claim 27,

wherein each of said AC power transfers of said AC power transfer collection has an associated amount of energy from an associated first node of said AC power network to a second node of said AC power network; and

said program code segment supporting contracting said sum of said associated AC power transfer for each of said AC power transfers of said AC power transfer collection on each of said flow gates of said flow gate collection comprises  
20

a program code segment essentially calculating an amount of energy of  
25 said associated AC power transfer on each of said flow gates of said flow gate collection as essentially an associated linear, skew-symmetric function of said associated amount of energy from said associated first node to said associated second node.

31. The program operating system of Claim 25,

wherein each of said flow gates of said flow gate collection is a significant flow gate of said AC power network.

32. The program operating system of Claim 25,  
wherein each significant flow gate of said AC power network is a flow gate  
5 in said flow gate collection.

33. The program operating system of Claim 25,  
wherein said program code segment supporting contracting for said AC  
power transfer on said AC power network further comprises;  
a program code segment supporting contracting for said AC power  
10 transfer on said AC power network to create an agreed contract by a first party to  
own AC power transfer trading rights with associated AC power transfers on  
each of said flow gates of said flow gate collection; and  
a program code segment supporting enabling said first party to further  
contract to sell said first party owned AC power transfer trading rights.

15 34. The program operating system of Claim 33,  
wherein each of said flow gates of said flow gate collection has an  
associated maximum safe carrying capacity; and  
further comprising a program code segment supporting scheduling said  
AC power transfer for said agreed contract comprising;  
20 a program code segment supporting determining whether said associated  
AC power transfer of said flow gate of said flow gate collection satisfies said  
associated maximum safe carrying capacity of said flow gate for each of said  
flow gates of said flow gate collection; and  
a program code segment supporting approving said AC power transfer  
25 whenever said associated AC power transfer of said flow gate satisfies said  
maximum safe carrying capacity for each said flow gates of said flow gate  
collection.

35. The program operating system of Claim 34,



wherein performing said program code segment supporting enabling said first party to further contract to sell said first party owned AC power transfer trading rights occurs before performing said program code segment supporting scheduling said AC power transfer for said agreed contract.

5 36. The program operating system of Claim 34,  
wherein said agreed contract by said first party to own said AC power transfer trading rights is to take place over a first time interval; and  
wherein performing said program code segment supporting scheduling said AC power transfer for said agreed contract occurs before said first time  
10 interval.

37. The program operating system of Claim 36,  
wherein determining whether said associated AC power transfer of said flow gate of said flow gate collection satisfies said associated maximum safe carrying capacity of said flow gate for each of said flow gates of said flow gate  
15 collection further comprises;

determining whether said associated AC power transfer of said flow gate of said flow gate collection satisfies said associated maximum safe carrying capacity of said flow gate for each of said flow gates of said flow gate collection over said first time interval; and

20 wherein approving said AC power transfer whenever said associated AC power transfer of said flow gate satisfies said maximum safe carrying capacity for each of said flow gates of said flow gate collection further comprises;

approving said AC power transfer over said first time interval whenever said associated AC power transfer of said flow gate satisfies said maximum safe carrying capacity for each said flow gates of said flow gate collection over said  
25 first time interval.

38. The program operating system of Claim 37, further comprising:  
a program code segment supporting contracting for an AC power transfer collection of at least one AC power transfer to create an agreed contract by a

first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection further comprises;

5 a program code segment supporting contracting for a sum of associated AC power transfers for all AC power transfers of said AC power transfer collection to create a contract for an associated AC power transfer for said collection of AC power transfers for each of said flow gates of said flow gate collection.

39. The program operating system of Claim 38,

10 wherein each of said AC power transfers of said AC power transfer collection has an associated amount of energy from an associated first node of said AC power network to said second node of said AC power network;

15 wherein a program code segment supporting contracting for a sum of associated AC power transfers for all AC power transfers of said AC power transfer collection to create a contract for an associated AC power transfer for said collection of AC power transfers for each of said flow gates of said flow gate collection comprises;

20 a program code segment calculating each of said associated AC power transfers on said flow gate of said AC power transfer has an amount of energy as an essentially linear, skew-symmetric function of said amount of energy from said associated first node to said associated second node of said AC power transfer of each of said flow gates of said flow gate collection.

40. The program operating system of Claim 33,

25 wherein said program code segment supporting enabling said first party to further contract to sell said first party owned AC power transfer trading rights further comprises;

a program code segment supporting enabling said first party to further contract to sell said first party owned AC power transfer trading rights for said

associated AC power transfer for a first of said flow gates of said flow gate collection.

41. The program operating system of Claim 40,

wherein said program code segment supporting enabling said first party to  
5 further contract to sell said first party owned AC power transfer trading rights  
further comprises;

a program code segment supporting enabling said first party to further  
contract to sell said first party owned AC power transfer trading rights for said  
associated AC power transfer for each of said flow gates of said flow gate  
10 collection.

42. The program operating system of Claim 33,  
wherein said first party is a human being.

43. The program operating system of Claim 42,  
wherein said first party is a corporate entity.

15 44. The program operating system of Claim 43,  
wherein said first party is represented by an agent authorized by said first  
party to act on behalf of said first party with respect to contracting said AC power  
transfer.

45. The program operating system of Claim 25,  
20 wherein said computing system is further comprised of  
a client computer collection containing at least one client computer with  
coupled computer readable memory operated by a client;  
a server system containing at least one server computer with coupled  
computer readable memory; and  
25 a network coupling each of said client computers of said client computer  
collection and coupling at least a first of said server computers of said server  
system; and

wherein said program code segment supporting contracting said AC power transfer on said AC power network further comprises;

5 a program code segment residing in said computer readable memory coupled to at least one of said server computers of said server system supporting identifying a first of said clients operating a first of said client computers as said first party.

46. The program operating system of Claim 45, further comprising

10 a program code segment supporting said first client user operating said first client computer as said first party residing on said computer readable memory coupled to said first client computer comprising:

a program code segment supporting receiving stimulus from said first user to create a received stimulus stream;

15 a program code segment supporting communicating via said network with said first server computer to create a received server stream and to create a server delivery stream; and

a program code segment supporting displaying a status based upon said received stimulus stream and said received server stream; and

20 wherein said program code segment supporting contracting said AC power transfer on said AC power network further comprises;

a program code segment supporting communicating via said network with said first client computer to create a received server delivery stream.

47. The program operating system of Claim 46,

wherein said program code segment supporting contracting AC power transfer on said AC power network further comprises;

25 a program code segment supporting operating a virtual trading floor containing a market interval for trading AC power transfer for each of said flow gates of said flow gate collection further comprising;

a program code segment supporting transforming said received server delivery stream into an order collection containing at least one bid order and at least one ask order; and

5 a program code segment supporting contracting AC power transfer on said AC power network to create an agreed contract based upon a first of said bid orders of said order collection and based upon a first of said ask orders of said order collection.

48. The program operating system of Claim 47,

10 wherein each of said validated orders of said validated order collection belongs to a collection comprising a bid type and an ask type;

wherein program code segment supporting contracting said AC power transfer on said AC power network to create an agreed contract further comprises

15 a program code segment supporting contracting said AC power transfer on said AC power network to create an agreed contract based upon a first bid type order of said validated orders of said validated order collection and a first ask type order of said validated orders of said validated order collection.

49. The program operating system of Claim 48,

20 wherein supporting contracting for said AC power transfer on said AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection further comprises;

25 a program code segment supporting contracting for said AC power transfer on said AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection based upon a first bid type order of said validated orders of said validated order collection and a first ask type order of said validated orders of said validated order collection.

50. The program operating system of Claim 48,  
wherein at least one market interval is associated with each flow gate of  
said flow gate collection.

51. The program operating system of Claim 50,

5 wherein said server system is further comprised of a reliable server  
collection of server computers performing a reliable distributed system with a  
process group collection of at least one process group;

wherein each of said server computers is accessibly coupled with a  
computer memory, of said reliable server system; and

10 wherein said program operating system includes program code segments  
implementing at least one of the process groups of said collection of process  
groups.

52. A computing system supporting program operating system of program  
code segments with program code segments contracting an AC power transfer  
15 on an AC power network with a flow gate collection containing at least one flow  
gate, comprised of:

at least one computer, each of said computers in said computing system  
coupled to an associated computer readable memory;

20 wherein each of said program code segments resides in said computer  
readable memory coupled to at least one of said computers in said computing  
system;

wherein said program operating system contains a program code  
segment supporting contracting an AC power transfer on said AC power network  
further comprising;

25 a program code segment supporting contracting an associated AC power  
transfer on each of said flow gates of said flow gate collection.

53. A computing system of Claim 52,

wherein said program code segment supporting contracting for said AC  
power transfer on said AC power network further comprises;

a program code segment supporting contracting for said AC power transfer on said AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection; and

5 a program code segment supporting enabling said first party to further contract to sell said first party owned AC power transfer trading rights.

54. A computing system of Claim 53,

wherein each of said flow gates of said flow gate collection has an associated maximum safe carrying capacity; and

10 said program operating system further containing a program code segment supporting scheduling said AC power transfer for said agreed contract comprising;

a program code segment supporting determining whether said associated AC power transfer of said flow gate of said flow gate collection satisfies said  
15 associated maximum safe carrying capacity of said flow gate for each of said flow gates of said flow gate collection; and

a program code segment supporting approving said AC power transfer whenever said associated AC power transfer of said flow gate satisfies said maximum safe carrying capacity for each said flow gates of said flow gate  
20 collection.

55. A computing system of Claim 54, further comprised of:

a client computer collection containing at least one client computer with coupled computer readable memory operated by a client;

a server system containing at least one server computer with coupled  
25 computer readable memory; and

a network coupling each of said client computers of said client computer collection and coupling at least a first of said server computers of said server system; and

wherein said program code segment supporting contracting said AC power transfer on said AC power network further comprises

5 a program code segment residing in said computer readable memory coupled to at least one of said server computers of said server system supporting identifying a first of said clients operating a first of said client computers as said first party.

56. A computing system of Claim 55,

wherein said program operating system further comprising;

10 a program code segment supporting said first client user operating said first client computer as said first party residing on said computer readable memory coupled to said first client computer comprising;

a program code segment supporting receiving stimulus from said first user to create a received stimulus stream;

15 a program code segment supporting communicating via said network with said first server computer to create a received server stream and to create a server delivery stream; and

a program code segment supporting displaying a status based upon said received stimulus stream and said received server stream; and

20 wherein said program code segment supporting contracting said AC power transfer on said AC power network further comprises;

a program code segment supporting communicating via said network with said first client computer to create a received server delivery stream.

57. A computing system of Claim 56,

25 wherein said program code segment supporting contracting AC power transfer on said AC power network further comprises;

a program code segment supporting operating a virtual trading floor containing a market interval for trading AC power transfer for each of said flow gates of said flow gate collection further comprising



a program code segment supporting transforming said received server delivery stream into an order collection containing at least one bid order and at least one ask order; and

5 a program code segment supporting contracting AC power transfer on said AC power network to create an agreed contract based upon a first of said bid orders of said order collection and based upon a first of said ask orders of said order collection.

58. A computing system of Claim 57,

wherein each of said validated orders of said validated order collection  
10 belongs to a collection comprising a bid type and an ask type;

wherein said program code segment supporting contracting said AC power transfer on said AC power network to create an agreed contract further comprises;

15 a program code segment supporting contracting said AC power transfer on said AC power network to create an agreed contract based upon a first bid type order of said validated orders of said validated order collection and a first ask type order of said validated orders of said validated order collection.

59. A computing system of Claim 58,

20 wherein said program code segment supporting contracting for said AC power transfer on said AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection further comprises;

25 a program code segment supporting contracting for said AC power transfer on said AC power network to create an agreed contract by a first party to own AC power transfer trading rights with associated AC power transfers on each of said flow gates of said flow gate collection based upon a first bid type order of said validated orders of said validated order collection and a first ask type order of said validated orders of said validated order collection.

60. A computing system of Claim 59,

wherein at least one market interval is associated with each flow gate of said flow gate collection.

61. A computing system of Claim 60,

5 wherein said server system is further comprised of a reliable server collection of server computers performing a reliable distributed system with a process group collection of at least one process group;

wherein each of said server computers is accessibly coupled with a computer memory, of said reliable server system; and

10 wherein said program operating system includes program code segments implementing at least one of the process groups of said collection of process groups.

# **METHOD AND SYSTEM OF MANAGING AC ELECTRICAL POWER NETWORKS BASED UPON FLOW-GATE MARKET TRANSACTIONS**

## Abstract

- 5 A method and system is claimed for contracting AC power transfer on an AC power network with a flow gate collection containing at least one flow gate. The method and system include contracting an AC power transfer on said AC power network, further including contracting an associated AC power transfer on each of said flow gates of said flow gate collection.

10

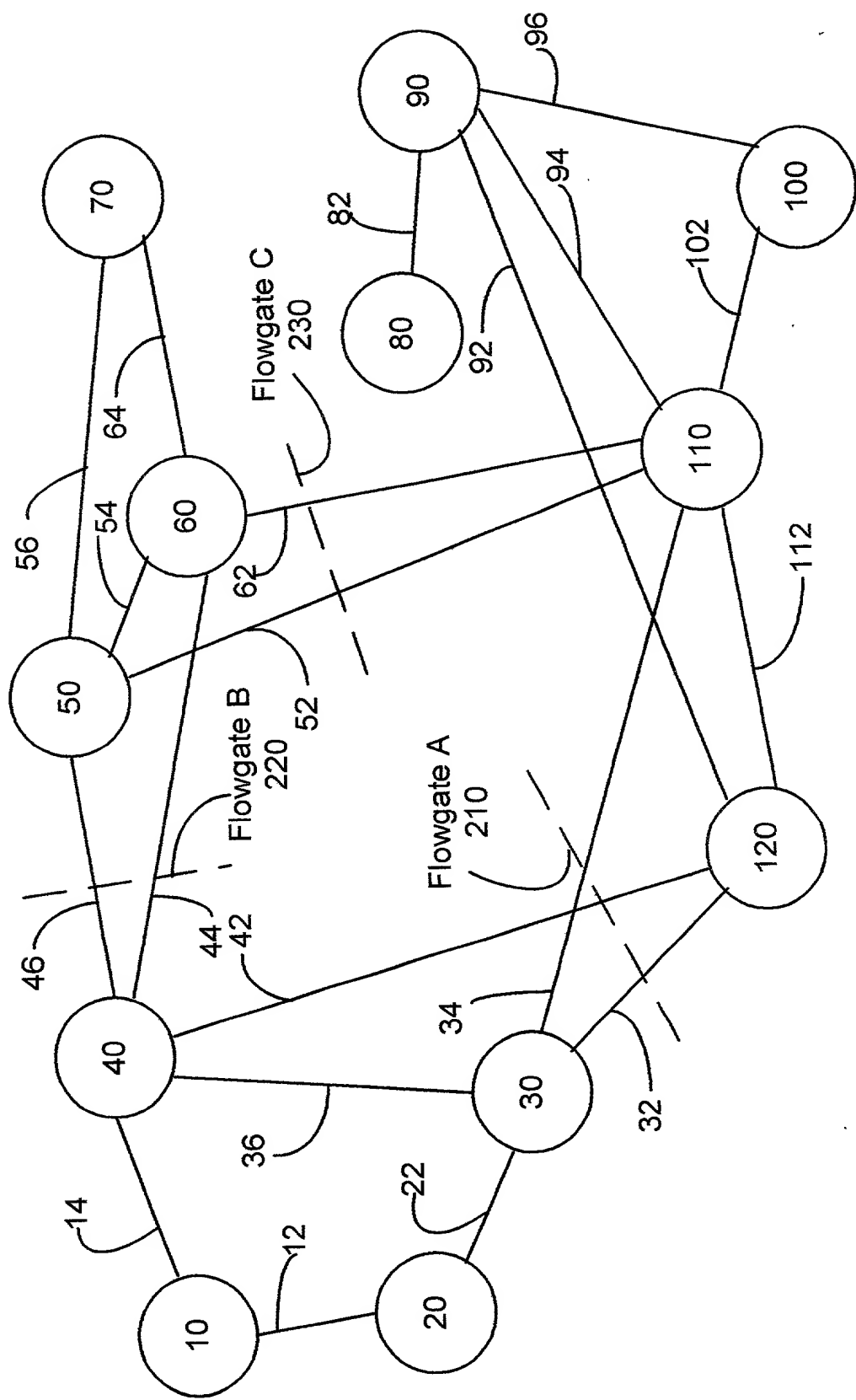


Fig. 1 Prior Art

Bus	Flowgate		
	A	B	C
1	0.70	0.30	0.30
2	0.80	0.20	0.20
3	0.90	0.10	0.10
4	0.60	0.40	0.40
5	0.60	-0.60	0.40
6	0.50	-0.50	0.50
7	0.55	-0.55	0.45
8	0.20	-0.20	-0.20
9	0.05	-0.05	-0.05
10	-0.01	0.01	0.01
11	0.00	0.00	0.00
12	-0.05	0.05	0.05

Fig. 2 Prior Art

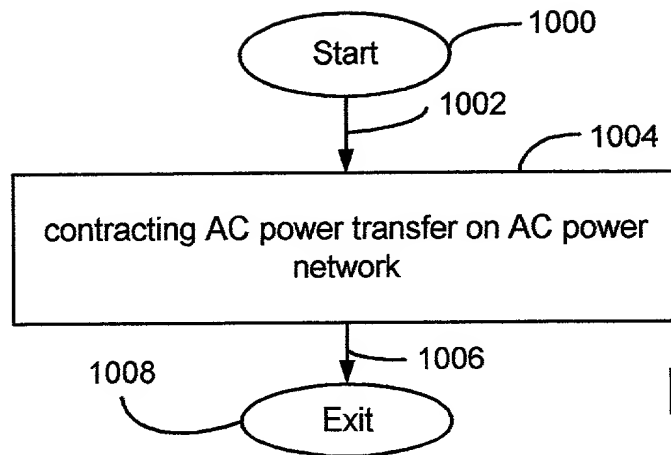


Fig. 3

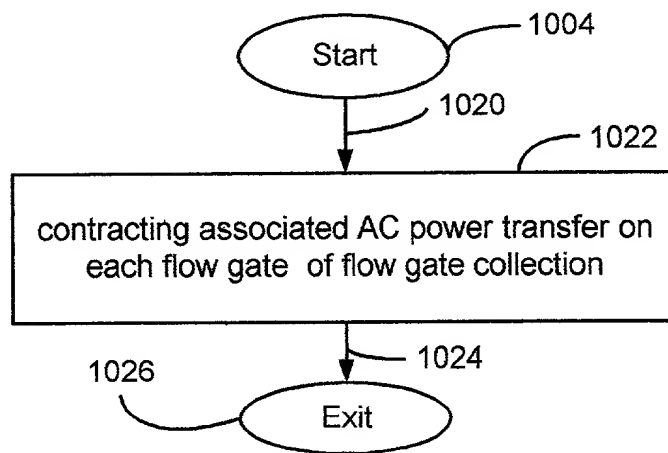


Fig. 4

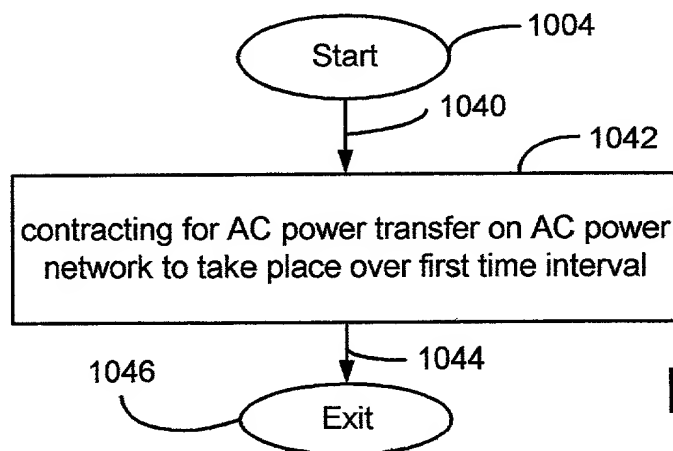


Fig. 5

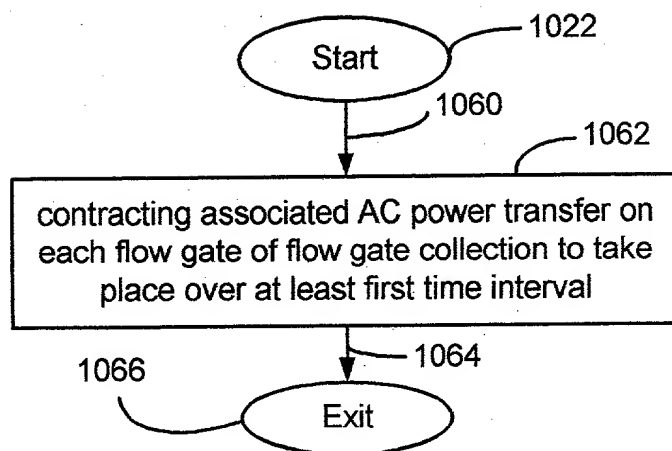


Fig. 6

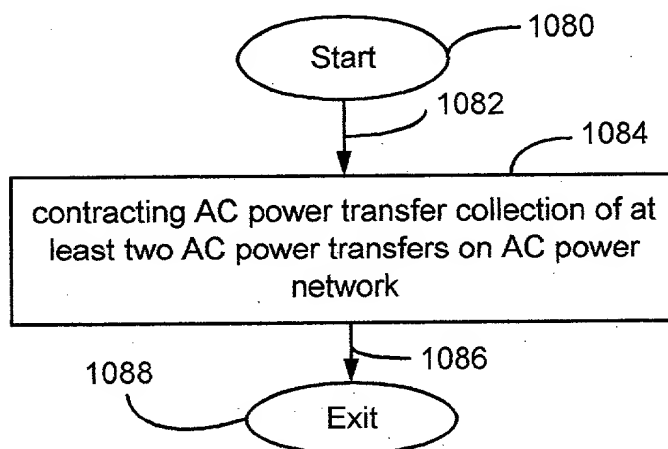


Fig. 7

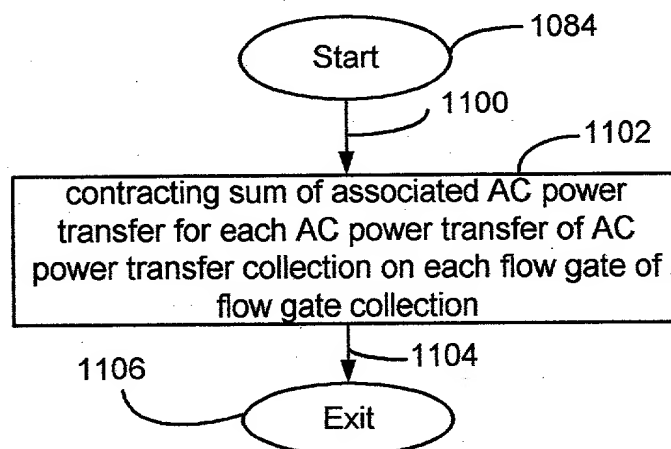


Fig. 8

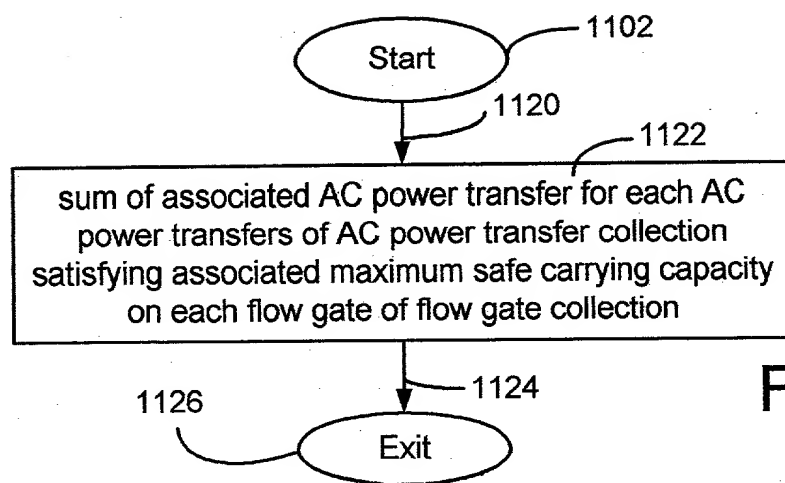


Fig. 9

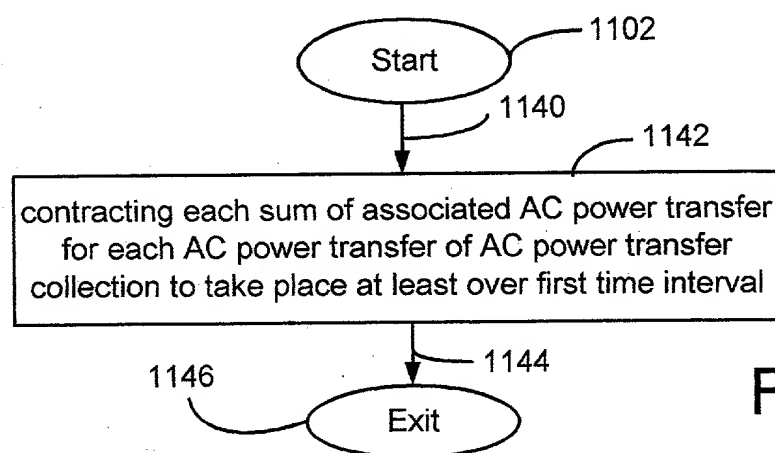


Fig. 10

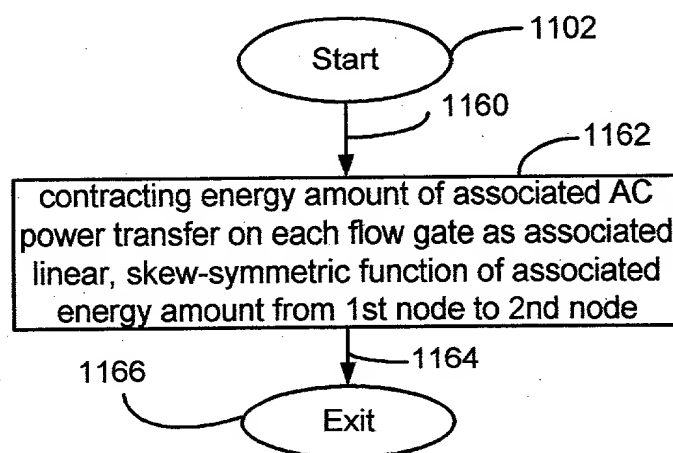


Fig. 11



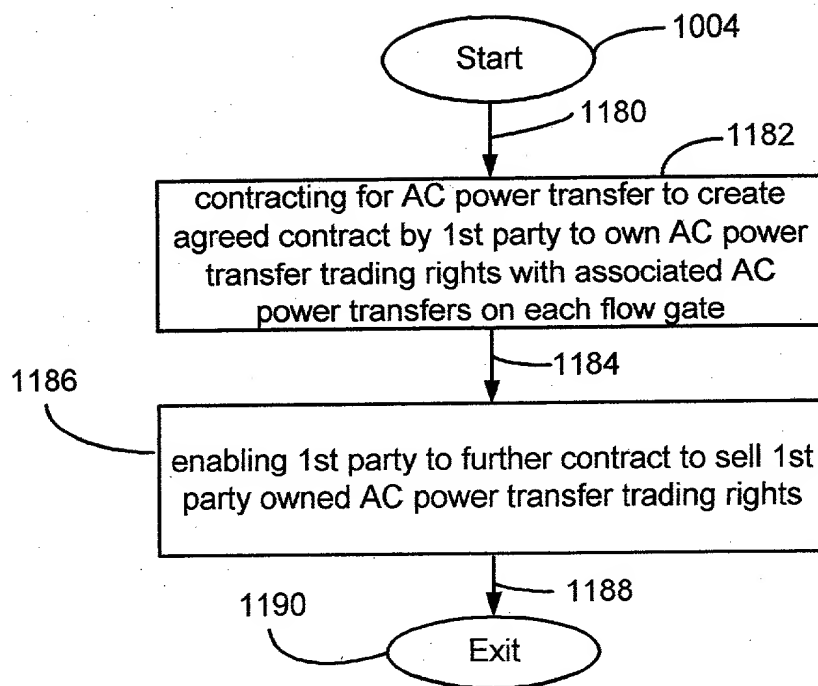


Fig. 12

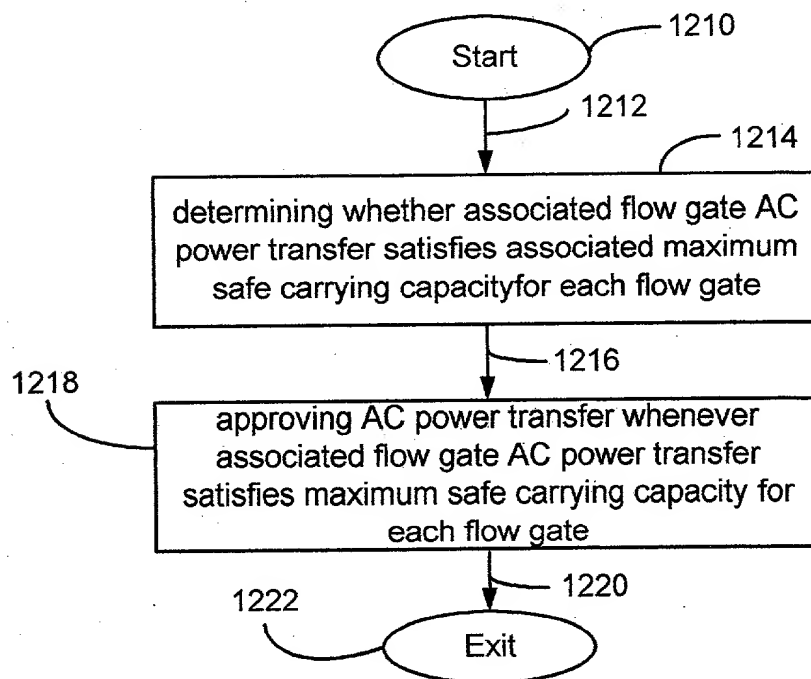


Fig. 13

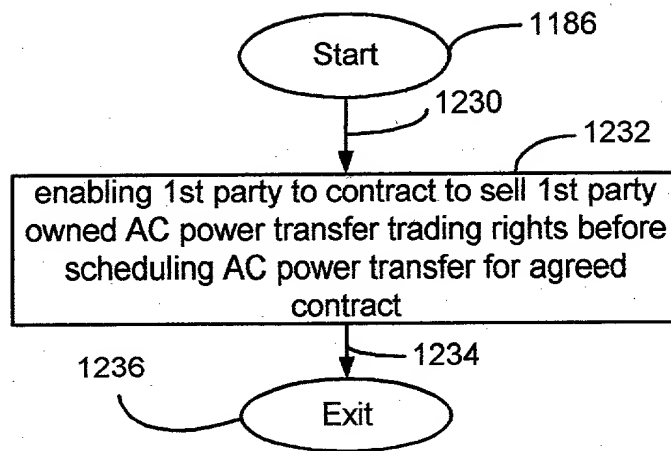


Fig. 14

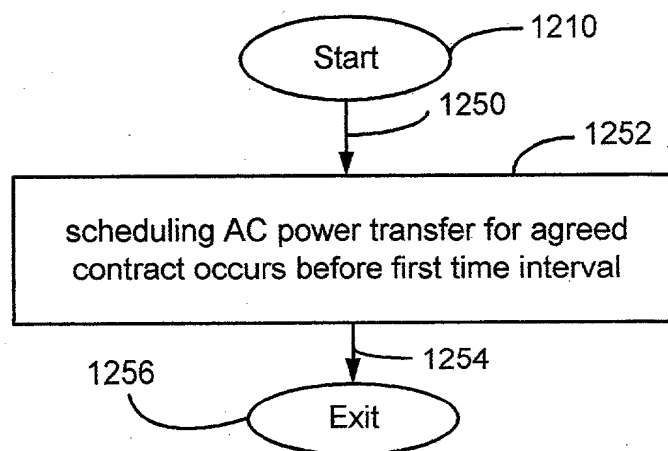


Fig. 15

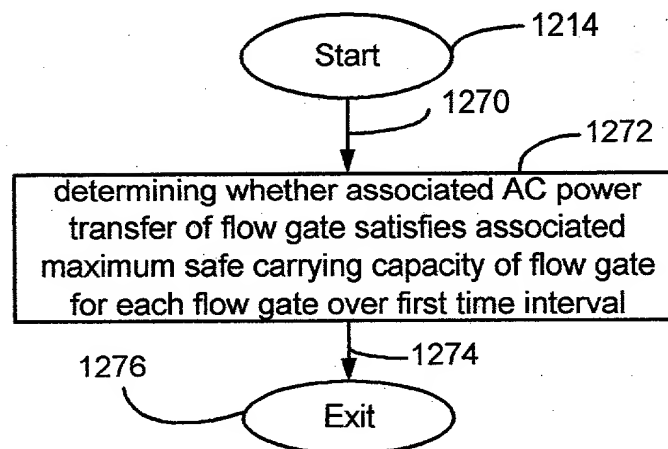


Fig. 16

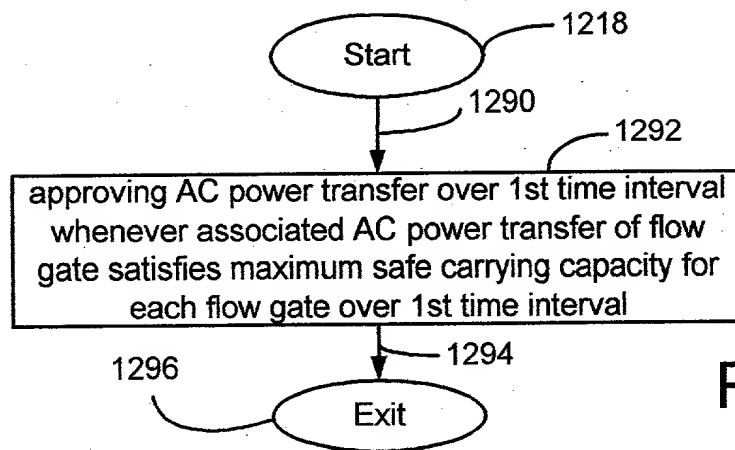


Fig. 17

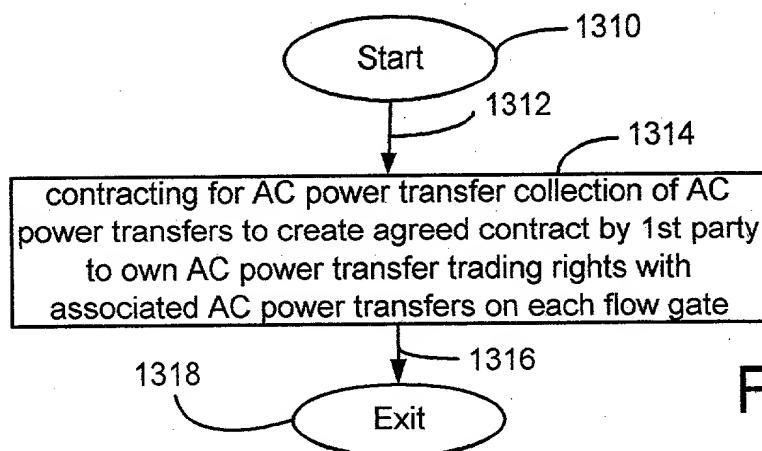


Fig. 18

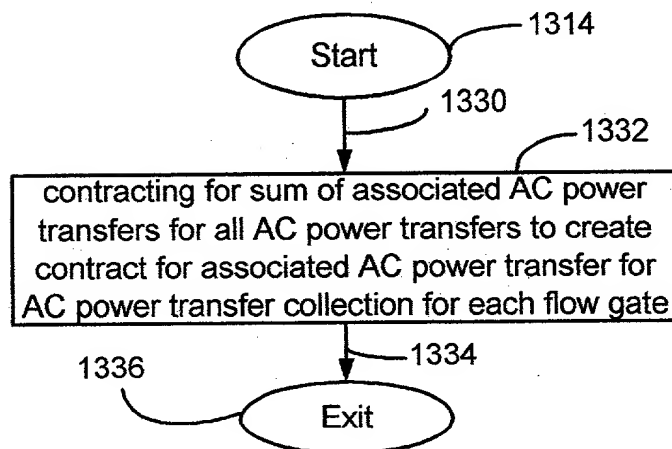


Fig. 19

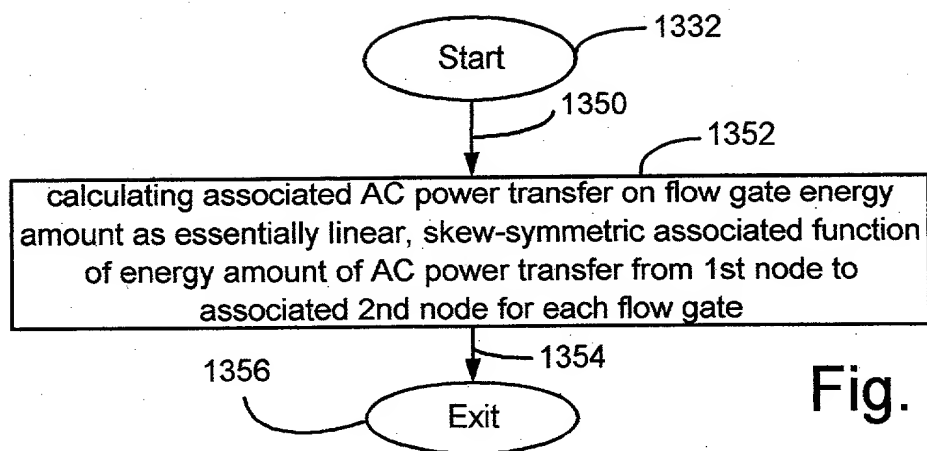


Fig. 20

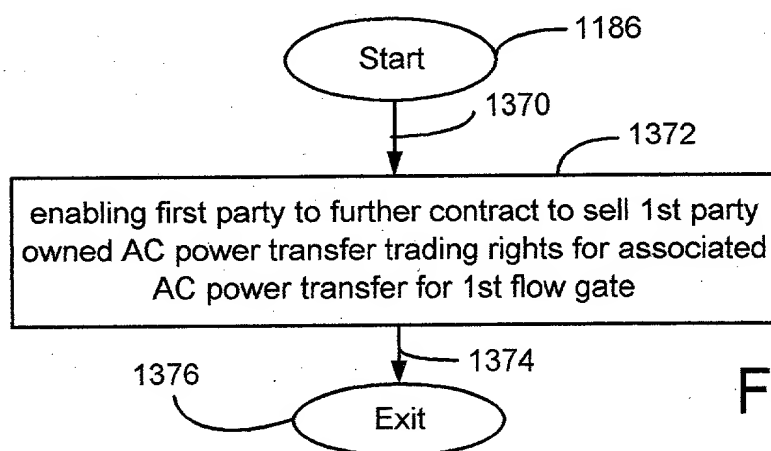


Fig. 21

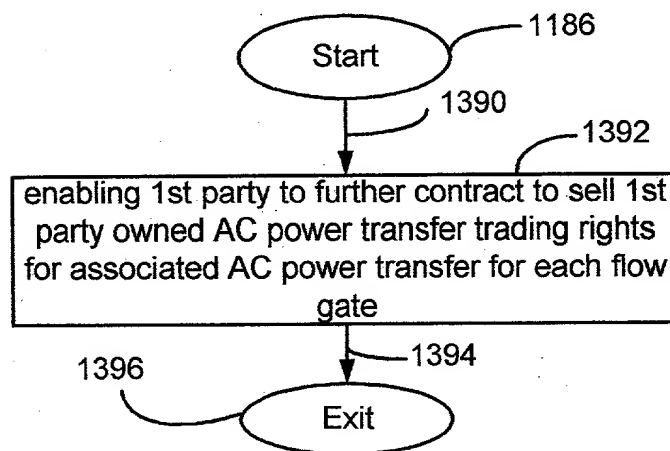


Fig. 22

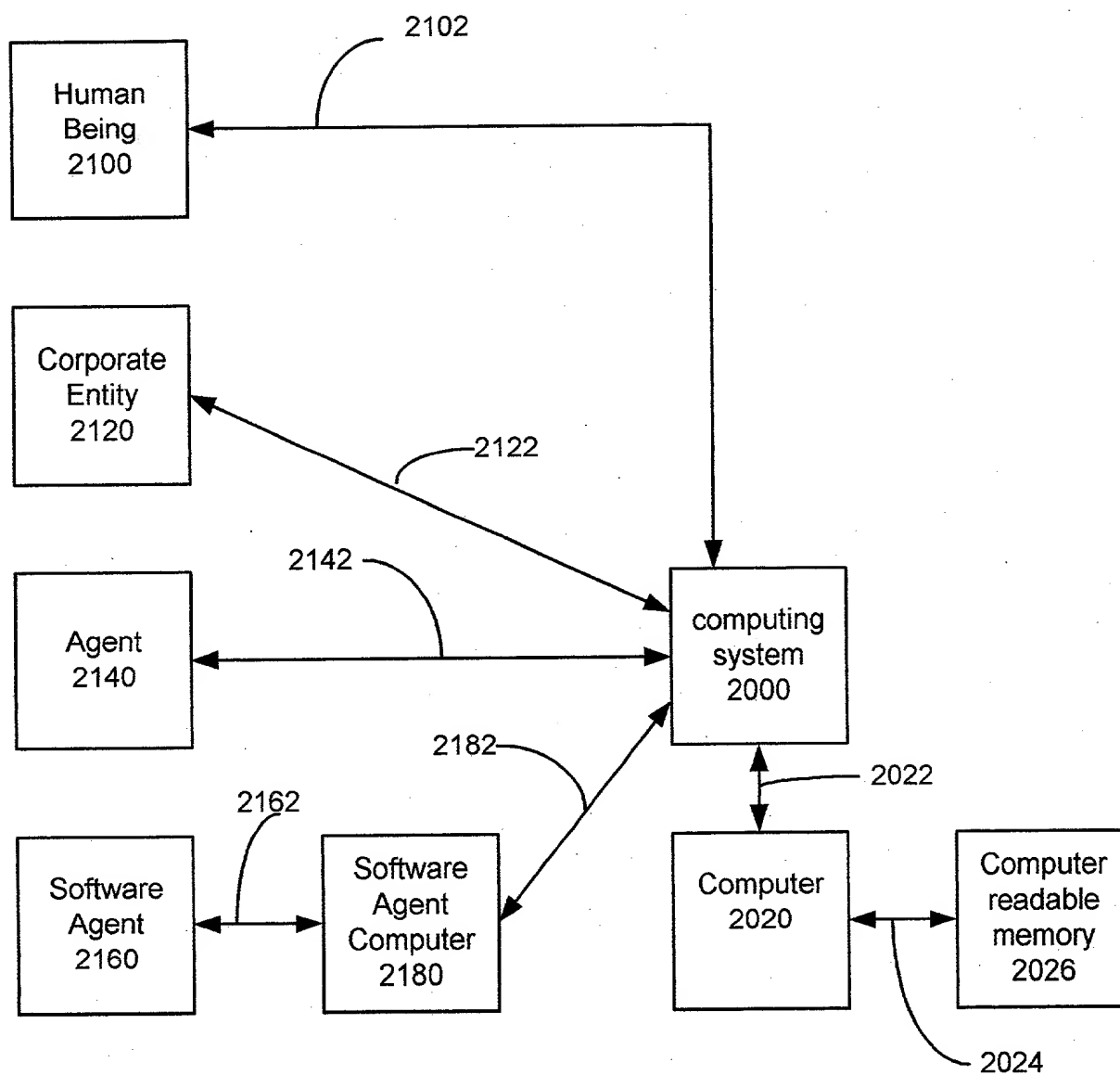


Fig. 23

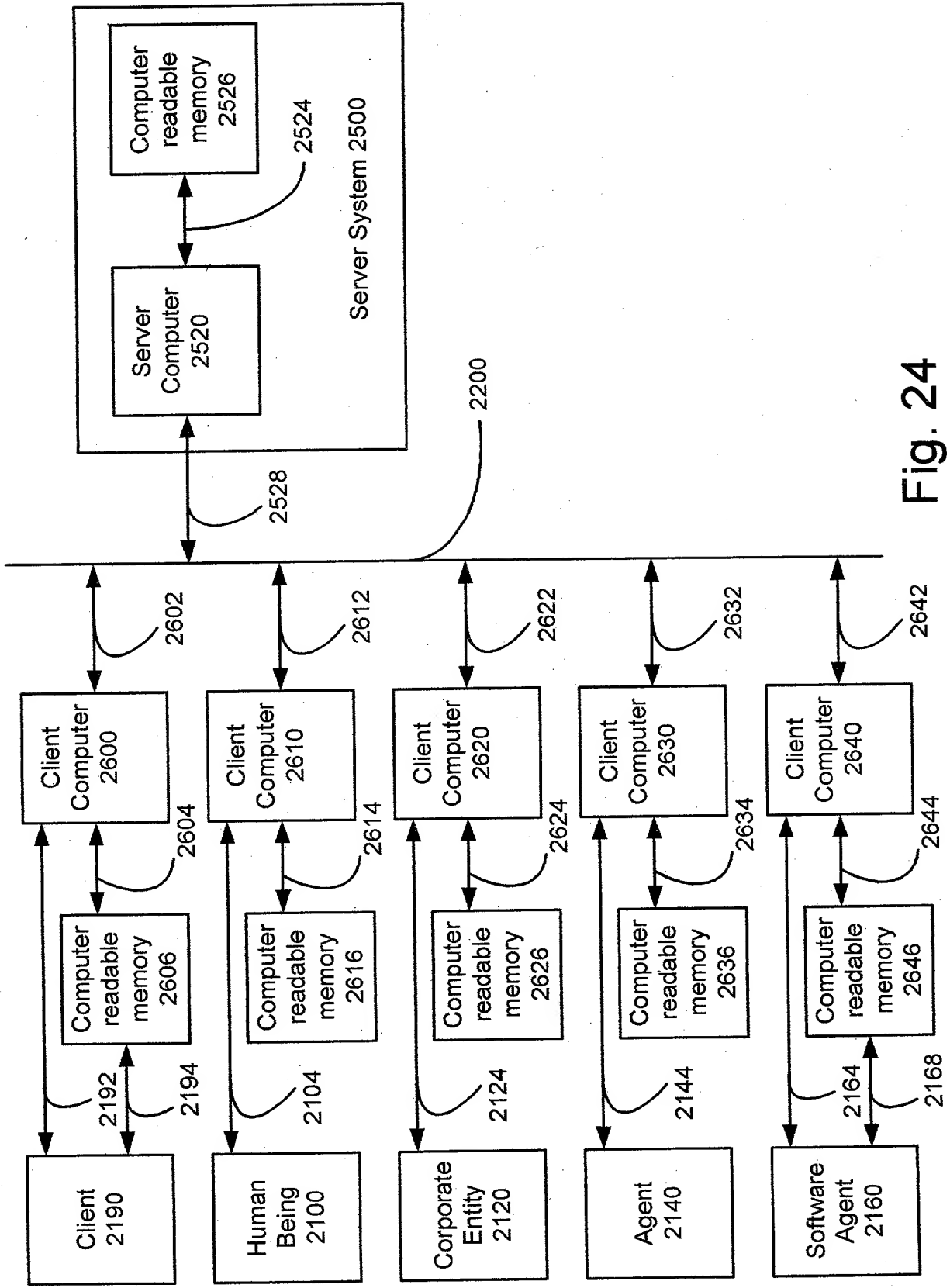


Fig. 24

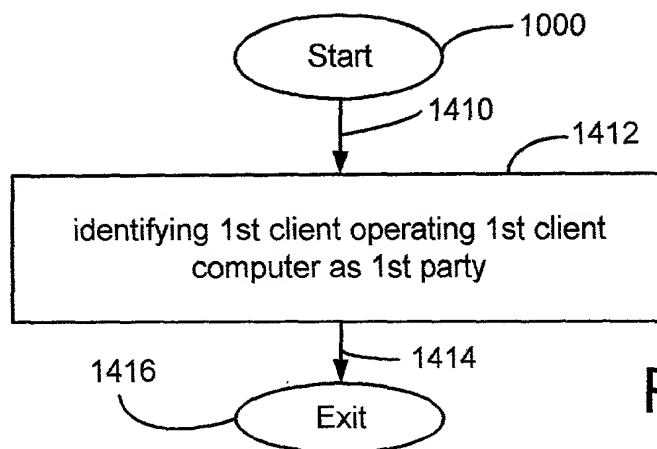


Fig. 25A

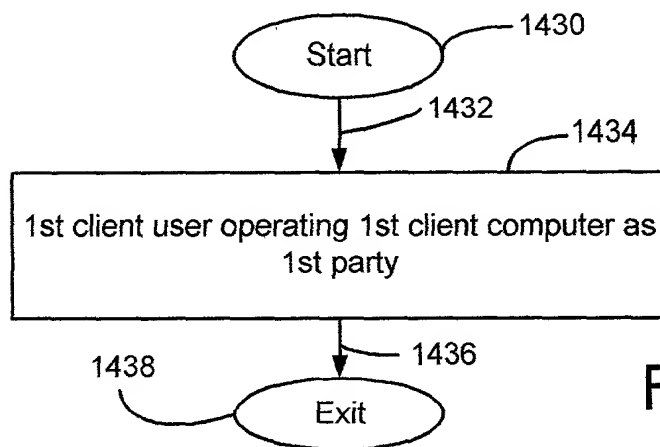


Fig. 25B

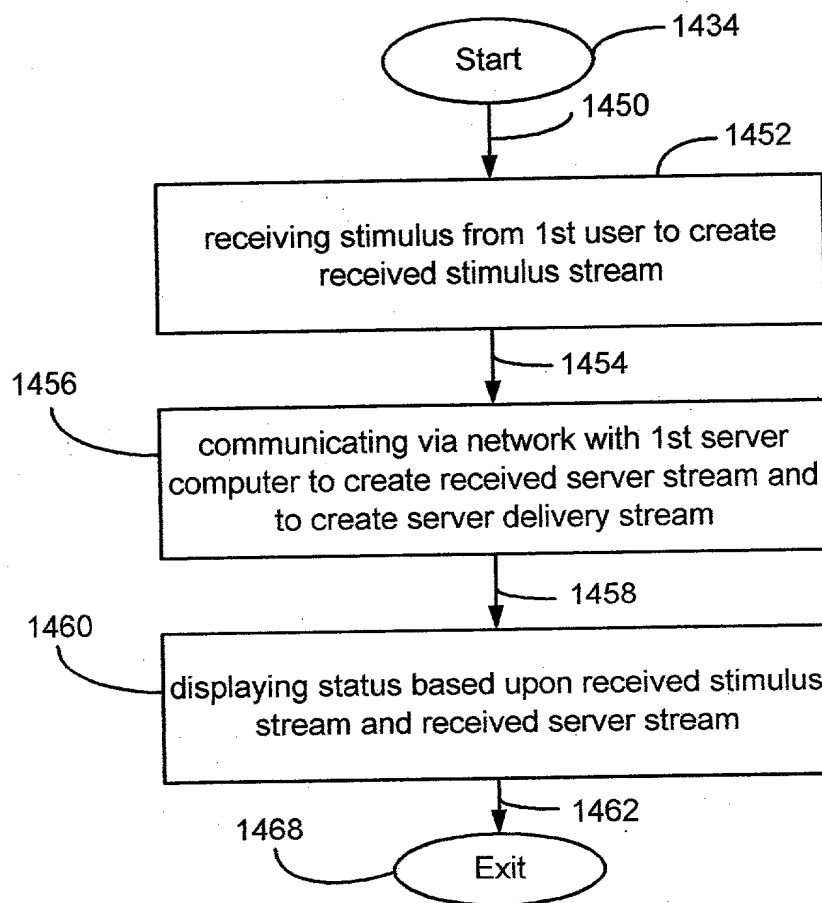


Fig. 26

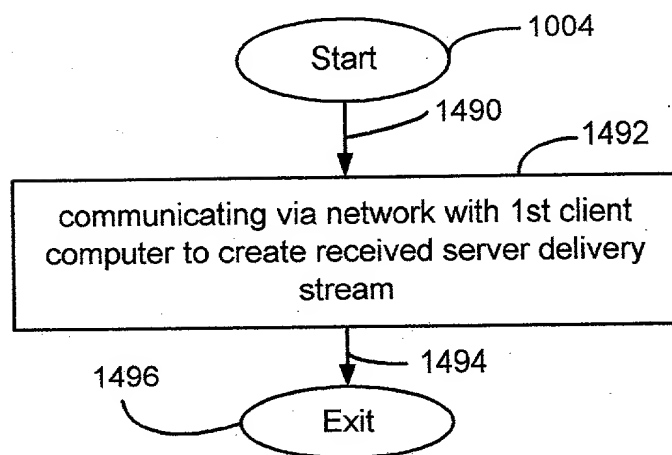


Fig. 27



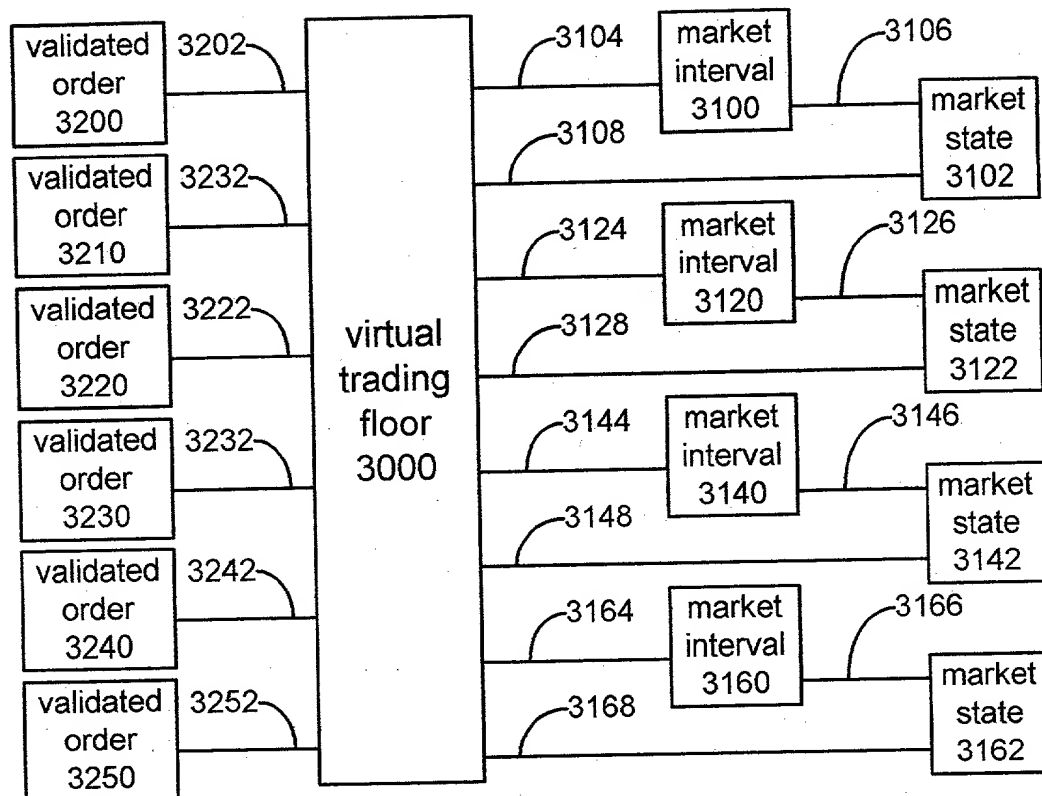


Fig. 28

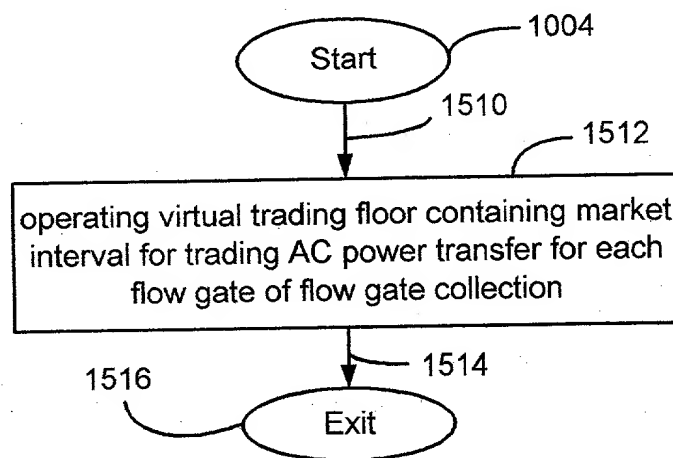


Fig. 29

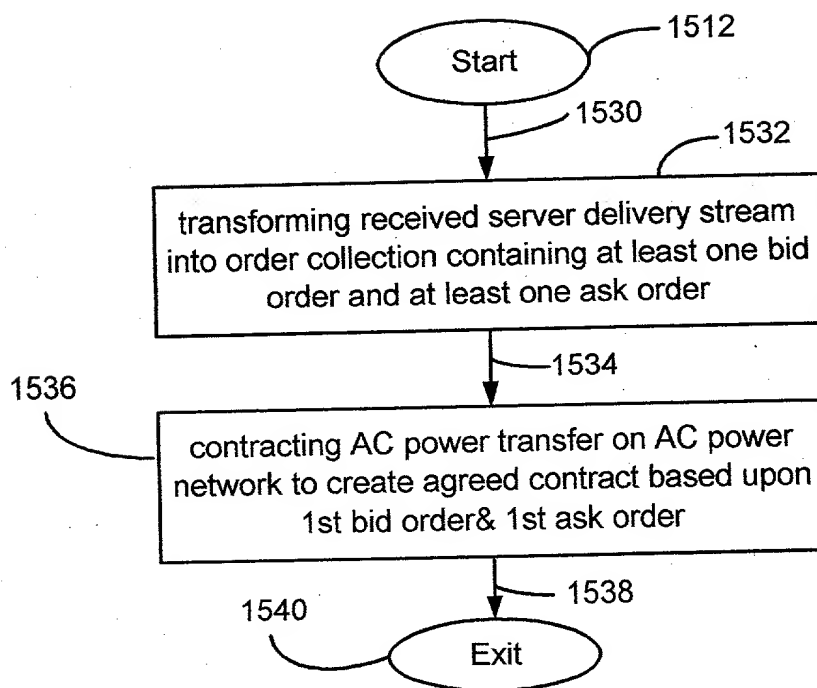


Fig. 30

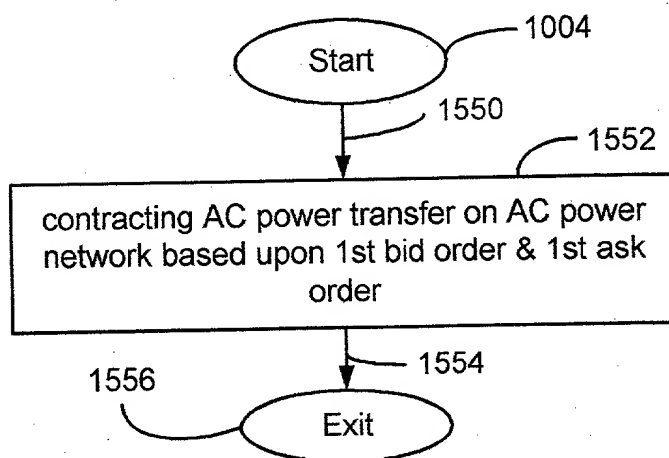


Fig. 31

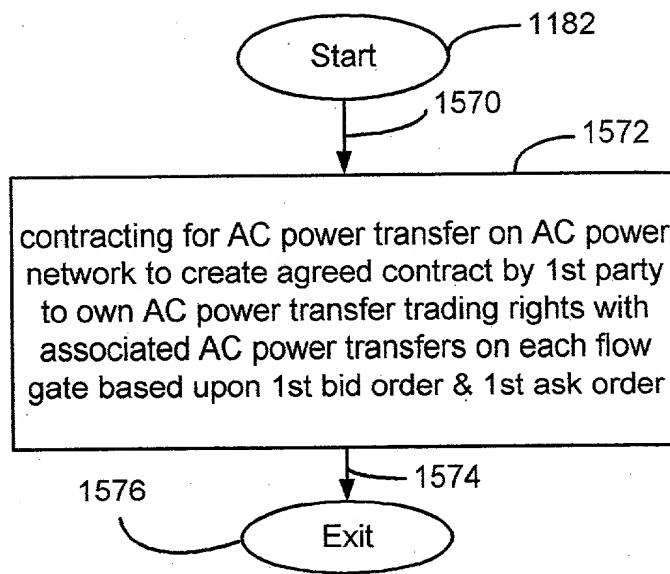


Fig. 32

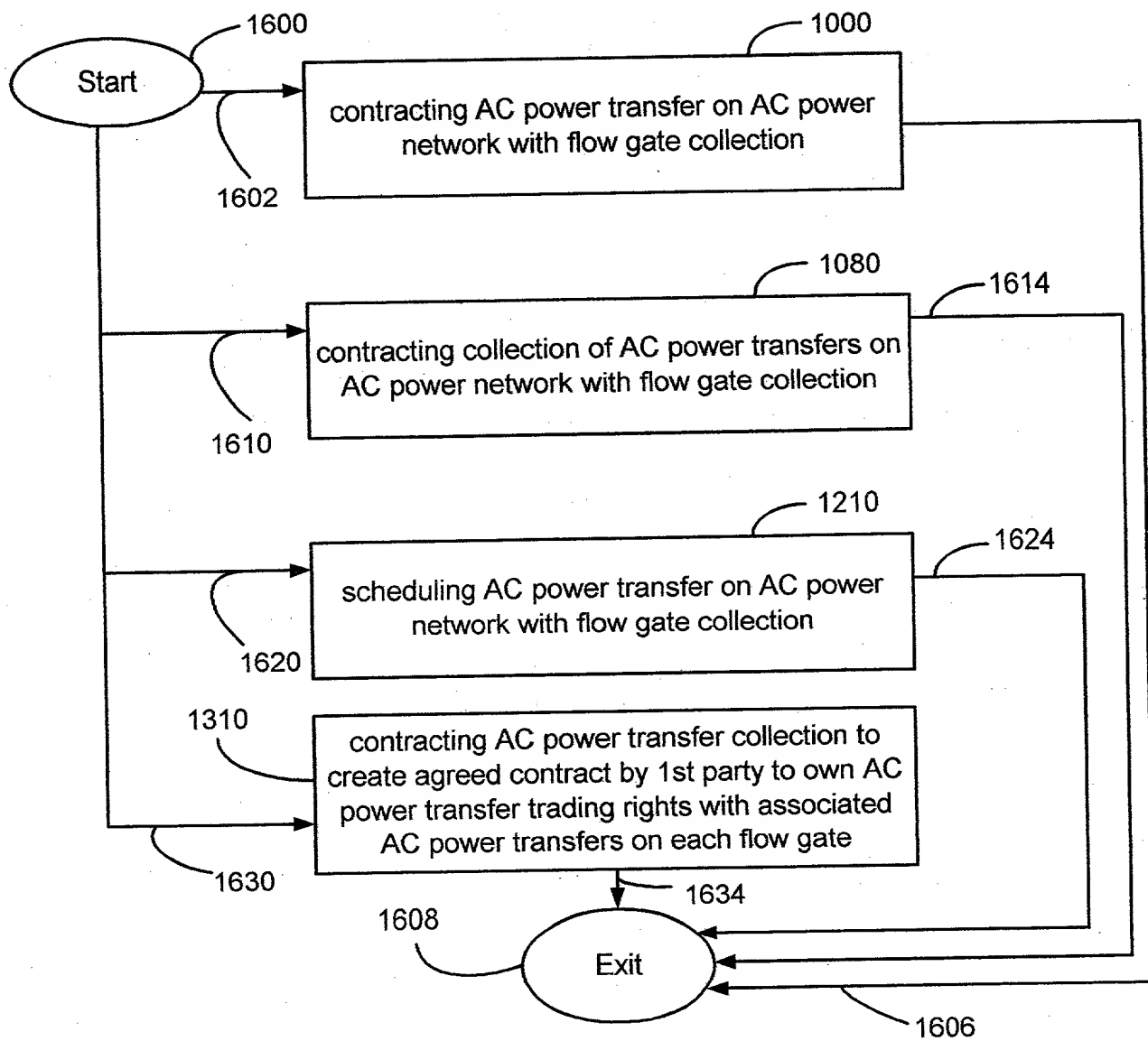


Fig. 33A

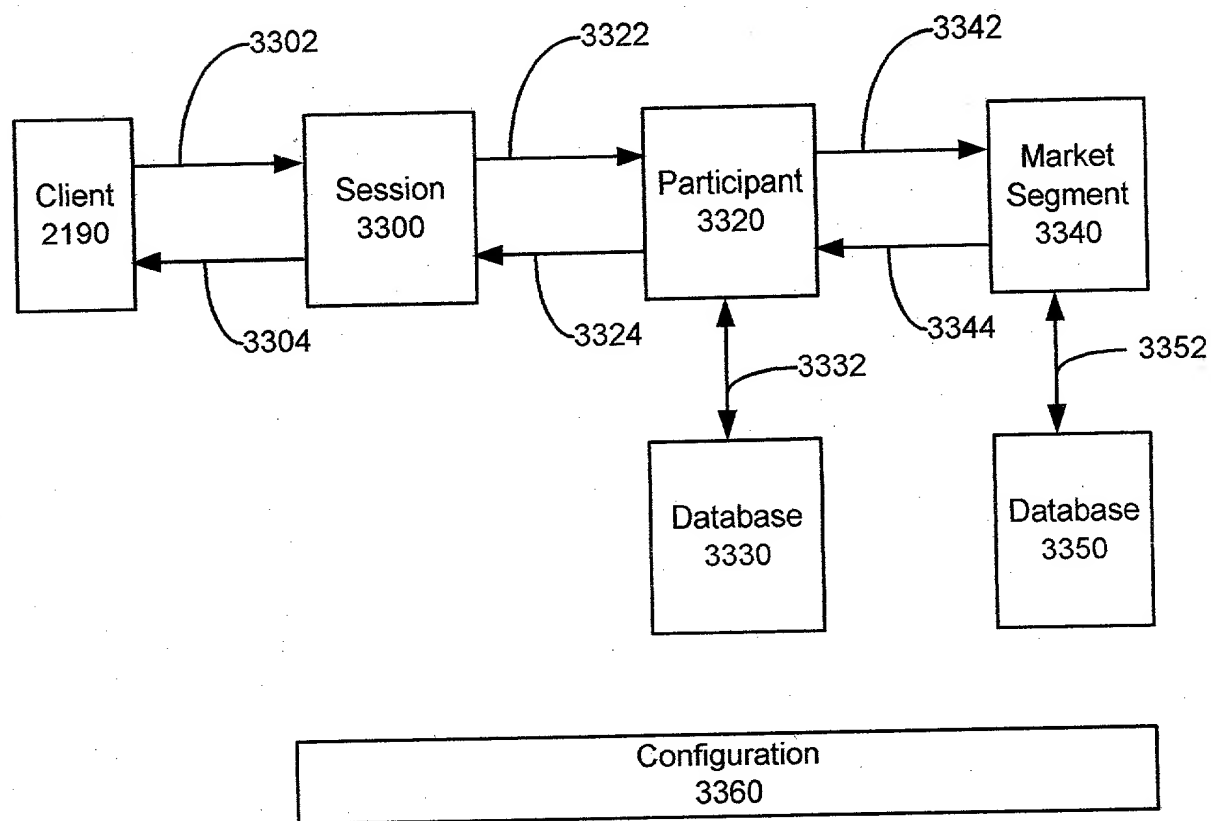


Fig. 33B

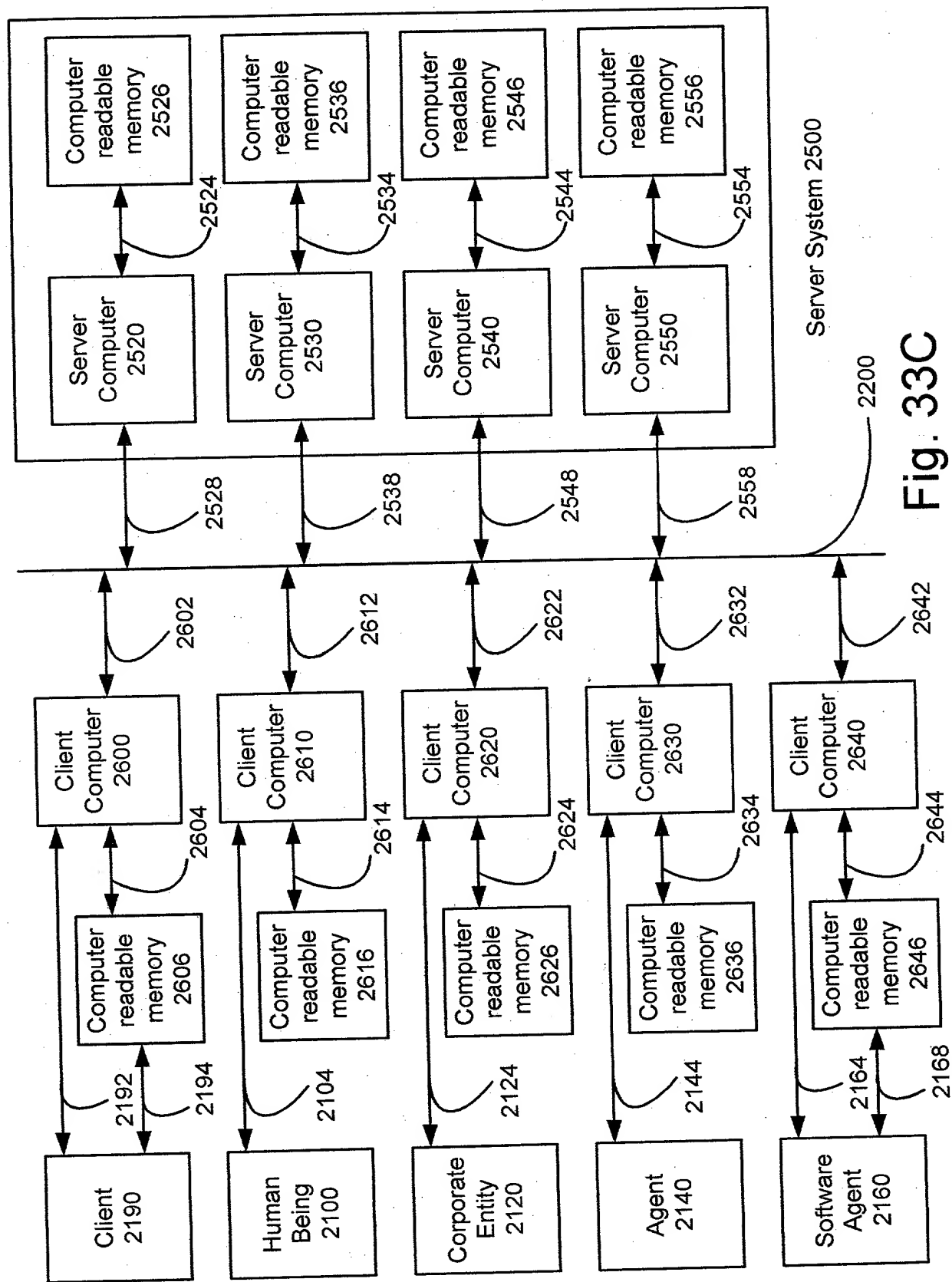


Fig. 33C

APX Market Window (TM) (Generation Resources (Participant Sale))

File Edit View Order Message Tools Window Help

**Generation**

November 1998

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

11/10/98 ◀ ▶ 11/11/98

**GMM**

Unit: COCOPP\_7 Unit 1 ▼

Sell APX Zone: Illinois ▼

Commodity: Hourly Energy ▼

Display Options: MW's of Total Only ▼

Market Depth: Highest Bid & Lowest Ask ▼

☐ Min & Max Order Allowed

☐ Local Time (GMT-05:00) Eastern Time ▼

☐ Generation Curve

**Order Options**

☐ At Market ☒ Limit

☐ Use Withdraw Date & Time

☐ Display order summary when submitting order(s)

☐ Display warning for orders outside native zone

☐ Only order in round lot multiple of 25 MW

	Market Time	Market Price (\$/MWh)	Contracted Position (Net MW)	Pending Position (NetMW)	Total Position (Net MW)	Highest Bid Quantity (\$/MWh)	Highest Bid Price (\$/MWh)	Lowest Ask Quantity (NetMW)	Lowest Ask Price (\$/MWh)	New Order (Net MW)	Limit Price (\$/MWh)	Limit Range
Ending (ST)												
1	14.54	0.00	0.00	0.00	0.00							
2	12.17	0.00	0.00	0.00	0.00	36.59	11.20	35.99	12.43	25.00	20.00	Or More
3	12.96	12.00	13.00	25.00	26.98	11.71	38.84	14.21	25.00	20.00	Or More	
4	14.45	12.00	13.00	25.00	32.41	12.99	40.76	15.40	25.00	20.00	Or More	
5	18.17	12.00	13.00	25.00	39.55	17.61	29.77	18.76	25.00	20.00	Or More	
6	19.91	12.00	13.00	25.00	45.61	18.02	25.56	20.54	25.00	20.00	Or More	
7	22.31	25.00	0.00	25.00	40.33	20.89	34.16	23.17	25.00	20.00	Or More	
8	22.42	25.00	0.00	25.00	50.94	22.39	43.08	24.12	25.00	20.00	Or More	
9	23.47	25.00	0.00	25.00	59.49	22.40	40.09	25.28	25.00	20.00	Or More	
10	24.05	25.00	0.00	25.00	61.26	24.05	46.29	25.28	25.00	20.00	Or More	
11	24.17	25.00	0.00	25.00	26.94	24.17	50.06	24.71	25.00	20.00	Or More	
12	23.73	25.00	0.00	25.00	26.85	23.73	45.69	26.09	25.00	20.00	Or More	
13	23.30	25.00	0.00	25.00	35.01	23.19	46.22	25.39	25.00	20.00	Or More	
14	21.26	25.00	0.00	25.00	51.60	20.62	42.48	25.39	25.00	20.00	Or More	
15	22.37	25.00	0.00	25.00	56.34	21.99	44.09	24.04	25.00	20.00	Or More	
16	22.53	25.00	0.00	25.00	53.21	22.05	40.71	24.19	25.00	20.00	Or More	
17	22.75	25.00	0.00	25.00	28.80	21.40	42.38	23.75	25.00	20.00	Or More	
18	23.80	25.00	0.00	25.00	48.05	23.58	40.24	25.05	25.00	20.00	Or More	
19	24.75	25.00	0.00	25.00	38.89	24.05	34.85	26.81	25.00	20.00	Or More	
20	24.98	25.00	0.00	25.00	38.48	24.93	37.47	26.37	25.00	20.00	Or More	
21	24.07	25.00	0.00	25.00	31.43	23.64	31.10	25.47	25.00	20.00	Or More	
22	21.12	25.00	0.00	25.00	40.56	21.07	43.59	23.98	25.00	20.00	Or More	
23	19.83	12.00	0.00	25.00	43.24	17.75	31.24	21.01	25.00	20.00	Or More	
24	17.06	12.00	0.00	25.00	41.08	15.27	33.41	19.29	25.00	20.00	Or More	

Submit Withdraw Summary

Save Refresh

Fig. 34

## File Edit View Order Message Tools Window Help

[illegible]

**Fig. 35**



4200

APX Market Window (TM) (Flowgate Trading)																																																					
File Edit View Order Message Tools Window Help																																																					
<div style="display: flex; justify-content: space-between;"> <div> <p>May 1999</p> <table border="1" style="font-size: small;"> <tr><th>Sun</th><th>Mon</th><th>Tue</th><th>Wed</th><th>Thu</th><th>Fri</th><th>Sat</th></tr> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td></td><td></td><td></td><td></td><td></td></tr> </table> <p>5/10/99 ◀ ▶ 5/10/99</p> </div> <div> <p>Flowgate: <span style="border: 1px solid black; padding: 2px;">COCOPP_7_Unit 1</span> ▼</p> <p>Commodity: <span style="border: 1px solid black; padding: 2px;">Hourly Flowgate</span> ▼</p> <p>Display Options</p> <p>Market Depth: <span style="border: 1px solid black; padding: 2px;">None</span> ▼</p> <p><input type="checkbox"/> Min &amp; Max Order Allowed</p> <p><input type="checkbox"/> Local Time <span style="border: 1px solid black; padding: 2px;">(GMT-00:00) GMT Time</span> ▼</p> </div> </div>						Sun	Mon	Tue	Wed	Thu	Fri	Sat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30						<p>4202</p> <p>Order Options</p> <p><input type="checkbox"/> At Market    <input checked="" type="radio"/> Limit</p> <p><input type="checkbox"/> Use Withdraw Date &amp; Time</p> <p><input type="checkbox"/> Display order summary when submitting order(s)</p> <p><input checked="" type="checkbox"/> Display warning for orders outside native zone</p> <p><input type="checkbox"/> Only order in round lot multiple of 25 MW</p>					
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																															
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8	9	10	11	12	13	14																																															
15	16	17	18	19	20	21																																															
22	23	24	25	26	27	28																																															
29	30																																																				
Market Time Hour	Market Price (\$/MWh)	Contracted Position (Net MW)	Pending Position (NetMW)	Total Position (NetMW)	New Order (NetMW)	Limit Price (\$/MWh)	Limit Range	N0CA->SoCA Contracted Flow (Net MW)	N0CA->SoCA Pending Flow (Net MW)	N0CA->SoCA Total Flow (Net MW)																																											
Ending (DT)																																																					
1	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
2	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
3	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
4	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
5	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
6	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
7	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
8	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
9	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
10	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
11	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
12	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
13	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
14	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
15	0.00	0.00	0.00	0.00				0.00	0.00	0.00																																											
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<div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; padding: 5px; margin: 0 10px;">4206</div> <div style="border: 1px solid black; width: 100px; height: 100px; margin: 0 10px;"></div> </div>																																																					
<div style="display: flex; justify-content: space-around; width: 100%;"> <span>Submit</span> <span>Withdraw</span> <span>Summary</span> </div>								<div style="display: flex; justify-content: space-around; width: 100%;"> <span>Save</span> <span>Refresh</span> </div>																																													

Fig. 36

## DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name;

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

### METHOD AND SYSTEM OF MANAGING AC POWER NETWORKS BASED UPON FLOW-GATE MARKET TRANSACTIONS

the specification of which (check one) ☒ is attached hereto, or \_\_\_\_\_ was filed on \_\_\_\_\_ as Application Serial No. \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

=====

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed  
Yes No

\_\_\_\_\_  
Number Country Day/Month/Year Filed

\_\_\_\_\_  
Number Country Day/Month/Year Filed

=====

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

MICHAEL A. GLENN, Reg. No. 30,176  
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CHRISTOPHER PEIL, Reg. No. 45,005

SEND CORRESPONDENCE TO:

MICHAEL A. GLENN, 3475 Edison Way, Suite L Menlo Park, CA 94025

=====

I hereby claim the benefit under Title 35, United States code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

60/163,213                      11/30/99                      PROVISIONAL -Pending  
Application Ser. No.              Filing Date                      Status: Patented, Pending, Abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Date

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Citizenship United States

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Citizenship United States

Full name of fifth joint inventor: TICHOMIR TENEV

Inventor's signature

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03/30/00

Date

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